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The war has reduced the opportunities for work based on Farnham House. Dr. Thompson, the Superintendent of the Laboratory, is now stationed at the Dominion Parasite Laboratory, Belleville, Ontario, Canada, where the Canadian Government has provided quarters and facilities for his work and that of his staff on the biological control of insect and plant pests. His senior assistant, Mr. E. Cameron, remains in the United Kingdom available for such work as can be done in that country.

Work on the natural enemies of animal and plant pests can now be undertaken in the temperate, subtropical and tropical regions of the Western Hemisphere. Entomologists in the countries of the British Commonwealth of Nations who wish to avail themselves of this opportunity for an extension of their biological control work are asked to communicate with Dr. W. R. Thompson, F.R.S., Imperial Parasite Service, Imperial Institute of Entomology, 228, Dundas Street, Belleville, Ontario, Canada, giving a detailed statement of their requirements.

Those who require parasites normally obtainable in the United Kingdom are asked to send their requests with similar details to The Director, Imperial Institute of Entomology, British Museum (Natural History), Cromwell Road, London, S.W.7, England.

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GRAHAM (C.). **The Plum Curculio.**—*Bull. Maryland agric. Exp. Sta.* no. 419 pp. 309–345, 32 graphs, 4 refs. College Park, Md, 1938. [Recd. 1940.]

An account is given of the technique and results of investigations carried out over periods ranging up to 8 years on various aspects of the life-history of *Conotrachelus nenuphar*, Hbst., on peach and, incidentally, apple in Maryland, with special reference to the effect on it of temperature and precipitation. The weevils overwinter under leaves and débris in woodland and fence rows near orchards, and, on entering the orchards in spring, they feed on the petals, sepals and tender leaves for 1–2 weeks until the fruits are large enough for oviposition. The larvae feed inside the fruits for several days, and then enter the soil, where development is completed. The resulting adults return to the trees, remain in the orchard until late September or October, and then seek sites for hibernation.

A knowledge of the date on which the weevils emerge from hibernation and enter the orchard is of importance in relation to control measures. It is dependent on temperature [*cf. R.A.E.*, A **21** 47; **22** 728], a daily mean temperature of 55°F. or above being necessary for 1–3 days before the weevils appeared in the orchards. The movements of the overwintered adults were determined by jarring the trees. The peak of emergence varied by as much as 21 days, and the stage of development of the peach trees at the time from full bloom to two-thirds of the fruits exposed from the sepals, while the averages of the daily mean temperature from 20th April until the date on which approximately 50 per cent. of the overwintered adults had entered the orchard ranged from 55 to 57°F., regardless of the date on which the emergence reached 50 per cent. The weevils were present on trees near woodland areas and other suitable hibernating quarters 3–17 days before reaching the centre of the orchard, and infestation was heaviest near hibernation quarters. Females fed and oviposited immediately after emergence from hibernation on apples that had been left in the open covered with leaves all the winter, but although they fed slightly on cherries that had been canned and stored apples, they did not oviposit in them.

In experiments to correlate the length of the egg stage with temperature, it varied from 9 to 14 days in May at average temperatures of 58–59°F., 10 to 12½ days in May at 58–65°F., and 5½ to 8½ days in June at 63–72°F. The average durations of the egg stage, the larval stage in the fruit, the larval stage in the soil, the pupal stage and the adult stage in the soil were about 10, 15, 13, 11 and 11 days. The date on which the larvae began to leave fallen peaches and apples ranged from 6th to 14th June, but when a dry period preceded the time when they would normally leave them, their emergence was retarded until rain moistened the small fruits, after which there was an abrupt rise in the numbers. If rain falls often enough to keep the fallen fruits soft while the larvae are within them, no sharp rise occurs. The depth in the soil at which the larvae pupated was not greater than 2½ ins. The percentage of larvae that gave rise to adults was 28·8. In years in which precipitation was heavy during the period spent in the soil, this percentage was generally extremely low, dead larvae, pupae and adults covered with a white mould being found in the soil, but in the seasons when the rainfall was light, it was high. During the early part of the period of adult emergence from the soil, increases in

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emergence generally followed rain. The date of first emergence ranged from 10th to 24th July, the last emergence in any one year being on 9th August. The time spent in the soil by the adult is dependent on precipitation. If the period preceding metamorphosis is very dry, the adult, although fully developed, remains in the soil until it is moistened by rain ; this period therefore may range from a few days to several weeks.

Females continued to deposit eggs for 2–4 days after being confined in a cage and fed on sprayed peach and apple twigs. Field and laboratory tests on the control of the adults showed that a spray of lead arsenate (2 lb. per 100 U.S. gals.) was more effective than 5, 10 or 15 per cent. lead-arsenate dusts, which were, however, satisfactory if infestation was light. Treatment should be applied three times, at petal fall, when nearly all the sepals are off the peaches, and two weeks later. Supplementary measures comprise burning woodland adjacent to the orchards to destroy hibernation sites, cultivating orchards between 8th and 18th July to kill the pupae, removing all early fallen fruit, and, if infestation is exceptionally heavy, jarring the trees.

HARRINGTON (C. D.) & SEARLS (E. M.). **Influence of the physiological Age of the Pea Plant on its Recovery from Aphid Damage.**—*J. agric. Res.* **60** no. 3 pp. 157–161, 2 figs. Washington, D.C., 1940.

During a test, carried out in Wisconsin in 1935, of the resistance to *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.) of 335 lots of peas, comprising 275 varieties varying in earliness of maturity though planted on the same date, the Aphids increased rapidly and reached destructive numbers, but were suddenly destroyed, apparently by fungi, when the early varieties had produced some well-developed seed. The extent of recovery of the plants after the disappearance of the Aphids appeared to be markedly influenced by the stage of maturity of the respective varieties at the time, non-recoveries predominating among the early varieties and recoveries among the late ones. It is concluded that the ability of the late varieties to produce a satisfactory crop of peas was evidence not of resistance but of escape, that comparative yield alone is not a reliable criterion of the ability of the plant to resist insect attack, and that the physiological age of the plants, not resistance, determines the ability of the various maturity groups to recover after an Aphid attack has stopped short of actual destruction of some of the varieties.

GINSBURG (J. M.). **Chemical Effect on Lead Arsenate of certain Salts which may be present in Soil and Spray Waters.**—*J. agric. Res.* **60** no. 3 pp. 199–205, 18 refs. Washington, D.C., 1940.

The following is based on the author's introduction and summary : Repeated spraying with lead arsenate during the growing season leads to a gradual deposition on orchard trees of appreciable quantities of arsenic, most of which reaches the soil, where it may accumulate for years, especially where drainage is poor. Moreover, the direct application of lead arsenate to the soil in comparatively large quantities for the control of larvae of such beetles as *Popillia japonica*, Newm., increases the possibility of accumulating large quantities of arsenic in certain soils. So long as the arsenic compound remains insoluble on the plant or in the soil, there is no

danger of injury to fruit trees or crops, but as soon as it comes in contact with water or water containing soluble salts, especially alkalis, chemical reactions may take place by which appreciable quantities of water-soluble arsenic may be released and become available for absorption by the plant roots. This so-called soluble arsenic may be in the form of arsenic acid or of water-soluble salts differing according to which bases, capable of displacing lead from the lead-arsenate molecule, are present in the solution. Both water in the soil and that used for spray may contain appreciable quantities of salts that may react directly with lead arsenate.

The investigation reported in this paper was made to determine which of the chemicals normally found in soils or spray waters react with lead arsenate to form soluble arsenic. Some 50 salts were mixed in various concentrations with constant quantities of acid lead arsenate (about 3 lb. per 100 U.S. gals.) and allowed to stand for 24 hours with frequent shaking. The filtrates of these mixtures were analysed for soluble arsenic. Of the 10 different groups of salts tested, the nitrates, sulphates and acetates, without exception, proved relatively non-reactive. The chlorides, silicates and bicarbonates produced moderate quantities of soluble arsenic, and carbonates and sulphides usually formed large percentages. In the phosphate group, the three phosphates of calcium and the monobasic phosphates of sodium and potassium formed inappreciable quantities of soluble arsenic, whereas the dibasic and especially the tribasic phosphates of either sodium or potassium formed large amounts.

The percentage solubility of a salt in water is, by itself, not a determining factor in forming soluble arsenic, but, of a group of salts possessing the property of decomposing lead arsenate, the salt that is highly soluble will form more than one that is only slightly soluble. The hydrogen-ion concentration of the salt solution plays, with few exceptions, an important part in decomposing lead arsenate. Salts with pH values of 8–11·4 produced, with two exceptions, more soluble arsenic than did those with lower pH values.

BOTTGER (G. T.). **Preliminary Studies of the nutritive Requirements of the European Corn Borer.**—*J. agric. Res.* **60** no. 4 pp. 249–257, 8 refs. Washington, D.C., 1940.

The following is based on the author's summary : During the spring of 1937, the nutritional requirements of larvae of *Pyrausta nubilalis*, Hb., were studied at Toledo, Ohio. The food materials represented distinct types in physical structure, stage of maturity, moisture content and chemical constituents, and both resistant and susceptible strains of maize. Moths reared from one lot of larvae collected in the previous autumn supplied the eggs and resulting larvae used for all the tests. A room-size incubator kept at a temperature of 80°F. and a relative humidity of 70–100 per cent. was used for the emerging moths, oviposition and the rearing of larvae on the foods.

As measured by statistically significant differences in percentage of larvae surviving and by the relatively high percentage pupating, sweet maize kernels satisfied their nutritive requirements better than any other material. Comparatively high percentages of larvae survived on green beans, lettuce and green peas, and the comparatively high weights of larvae nourished on these foods indicated that they provided satisfactory nutrition. Internodes of maize in general

provided satisfactory nutriment. The nutritive qualities of maize internodes, as measured by differences in survival and weight of the larvae, varied considerably in the strains tested. Extremely low survivals resulted from infestations induced on potato plants and mature tubers, hemp and sunflower plants. Soy-bean plants, maize tassels and beet leaves were the only green-plant food materials tested on which no larvae survived, although in the case of maize tassels, mortality may have been due to the poor condition of the food. Food materials rich in glucose fulfilled the nutritive requirements of the larvae far better than did those high in either sucrose or starch. There was a positive correlation between the percentage of larvae surviving and their average weight 30 days after hatching.

Physical characters of plants that were associated with low survivals and weights of larvae were profuse pubescence, thick epidermis and the greater number and coarse nature of the fibrovascular bundles, especially in the peripheral region of the stems. Excessive moisture in such succulent foods as young sunflower plants and potatoes apparently interfered with the tunnelling habits of the larvae. Insufficient moisture to satisfy their physiological requirements and physical structure of the plant tissue incompatible with their positive thigmotropism probably contributed more to the mortality of larvae on such foods as maize leaves and tassels than any deficiencies in nutritive elements.

Supplementary tests for enzymes in the cellular tissue of the digestive tracts of hibernating larvae indicated the presence of both sucrose- and protein-splitting enzymes, but no enzymes capable of hydrolysing starch were found. Metamorphic development of the insect was directly affected by nutrition. This observation suggests a possible explanation for the variation in number of generations, within a climatic range, on the basis of difference in the nutritive value of plants available in different environments [*cf. R.A.E.*, A **27** 414, 415].

St. John (J. L.), McCulloch (E. C.), Sotola (J.) & Todhunter (E. N.). **Toxicity to Sheep of Lead Arsenate and Lead Arsenate Spray Residues.**—*J. agric. Res.* **60** no. 5 pp. 317–329, 15 refs. Washington, D.C., 1940.

The following is taken from the authors' summary of investigations carried out as a result of occasional reports received at the Washington Experiment Station of the illness or death of cattle and sheep that had been pastured in sprayed orchards during autumn: Sheep were killed by the oral administration of 0·4–0·5 gm. arsenic (As) in the form of arsenic trioxide (As_2O_3), but substantially larger amounts of arsenic in the form of lead arsenate were required to kill. When lead arsenate was sprayed on foliage and allowed to remain for several weeks, still larger amounts were necessary. Nine sheep were fed with lead arsenate varying in amount from 2 to 0·25 gm. per sheep per day. Apples were included in some of the rations. The animals receiving 1 and 2 gm. per day died within a few days, in most cases after having received about 1·5 gm. arsenic (2 gm. As_2O_3). One animal that received 0·25 gm. lead arsenate per day survived for 35 days, and another that received the same amount for 94 days was in good condition at the end of 10 months, when it was slaughtered. A total of 1·5 gm. arsenic in the form of lead arsenate appears to be

approximately a lethal dose when fed in small amounts daily. This is equivalent to about 41·0 mg. arsenic or 192 mg. lead arsenate per kg. body weight.

VINSON (C. G.) & MCCRORY (S. A.). **Avoiding obvious Residue from Nicotine-bentonite Sprays.**—*Science* **92** no. 2378 p. 79, 1 ref. New York, 1940.

On account of reports of obvious heavy residue on fruit and foliage resulting from the use of nicotine-bentonite combinations, the authors call attention to their method of mixing nicotine sulphate and bentonite in a spray that gives no obvious residue [*R.A.E.*, A **27** 133]. When used [in Missouri] for the control of codling moth [*Cydia pomonella*, L.], such sprays compared very favourably with the standard spray of lead arsenate. About 87,000 apples were counted from the sprayed plots in 1939, and 92·4 per cent. were uninjured in the plots sprayed with the nicotine-bentonite combinations as compared with 91·3 per cent. in the plot sprayed with lead arsenate. The number of entries was slightly greater and the number of superficial injuries considerably higher in the latter plot.

WEISS (H. B.). **Money Losses due to Destructive Insects.**—*J. N. Y. ent. Soc.* **48** no. 2 pp. 195–199. New York, N.Y., 1940.

In the author's view, attempts to express losses caused by insects to crops in terms of money give completely misleading results. It is usually impossible to ascertain by how much a crop is reduced by insect attack, and, even if this is done, the theoretical quantity cannot be given a value based on that of the actual crop because the selling price of the latter would be reduced if a greater quantity came on the market.

MASON (P. W.). **A Revision of the North American Aphids of the Genus** *Myzus*.—*Misc. Publ. U. S. Dep. Agric.* no. 371, 30 pp., 7 figs., 35 refs. Washington, D.C., 1940.

This revision includes descriptions of various forms of the species of *Myzus* that occur in North America, with keys to the alate and apterous viviparous females of most of them. There are 3 new species, *viz.*, *M. sensoriatus*, found on *Crataegus crusgalli* in the District of Colombia, *M. lilii*, which is suspected of transmitting virus diseases of *Lilium candidum* in Oregon, and *M. scammelli*, which is reported to be injurious to cranberry in New Jersey and the New England States. In addition to such well-known pests as *M. persicae*, Sulz., other species of economic importance include *M. ornatus*, Laing, which has recently been recorded in California [*R.A.E.*, A **26** 589] and has been intercepted hundreds of times in quarantine in the United States on material from Europe, *M. varians*, Davidson, and *M. porosus*, Sand. *M. varians*, of which *M. tropicalis*, Tak. [**11** 441] and *M. clematifoliae*, Shinji, are synonyms, occurs in California, Japan, the Loochoo Islands and Formosa, and migrates between *Clematis* (the summer food-plant) and peach. It sometimes causes severe damage to peach in California by attacking the terminal twigs, as a result of which the leaves become

reddish in colour and the edges curl. *M. porosus* is the most common Aphid on rose in the Southern States and Mexico and also attacks strawberry, ovipositing on both food-plants.

WALKER (H. G.) & ANDERSON (L.D.). **The Hawaiian Beet Webworm and its Control.**—*Bull. Virginia Truck Exp. Sta.* no. 103 pp. 1651–1659, 4 figs., 3 refs. Norfolk, Va., 1940.

Hymenia recurvalis, F. (*fascialis*, Stoll) severely damaged autumn spinach in south-eastern Virginia in 1926 [*R.A.E.*, A **16** 36] and caused slight injury to autumn spinach sown before 5th September on many occasions during the next 12 years. In 1939 it was again very injurious ; many fields of spinach, including some sown as late as 15th September, were seriously injured and others completely destroyed. This Pyralid cannot overwinter in Virginia ; it breeds throughout the year further south and migrates northward as the season becomes warmer. It reaches Virginia in late summer and autumn, and breeds there until destroyed by cold weather. Its principal food-plants in Virginia are beet, spinach, *Chenopodium album* and *Amarantus* sp. ; it has also been stated to attack carrots, cotton, crucifers and purslane [*Portulaca oleracea*], but no larvae were observed on carrots and cotton near heavily infested spinach and beet in 1939.

The adults shelter beneath the leaves of cultivated plants during the day, but fly actively if disturbed, and, in 1939, were present in eastern Virginia in enormous numbers in fields and along ditch banks from the middle of September until the end of October. Eggs are deposited singly or in small groups on the lower surface of the leaves, and the larvae feed, sometimes beneath a silken web, on the lower leaf-tissues, rarely piercing the upper epidermis. They pupate a short distance below the surface of the soil in silk-lined cells. The length of the development period varies according to the season, but in general the egg, larval and pupal stages last 3–5, 10–15 and 10–15 days, respectively.

Investigations have indicated that arsenical sprays and dusts and derris and other rotenone-bearing dusts are of no value in control. In preliminary trials in 1939, a dust of 1 part Pyrocide [containing 2 per cent. pyrethrins] and 9 parts carrier applied at rates of 55–60 and 35–40 lb. per acre gave percentage mortalities of nearly 100 and over 80, respectively ; undiluted calcium arsenate applied at 35–40 lb. per acre at the same time had little effect. In further trials with dusts containing pyrethrum, all were beneficial, but the most effective and economical were Pyrocide or a commercial pyrethrum powder each diluted with talc to contain 0·2 per cent. pyrethrins, which gave 98 and 93 per cent. mortality, respectively, when applied at the rate of 35–45 lb. per acre. A percentage mortality of 98 was also given by 10 per cent. Pyrocide in sulphur and by a mixture of pyrethrum powder and talc containing 0·4 per cent. pyrethrins. A dust containing micronised pyrethrum diluted with tobacco dust and silica to contain 0·123 per cent. pyrethrins gave 82 per cent. mortality, but one in which the pyrethrin content was the same but the diluents were sulphur and clay gave only 60 per cent. A pyrethrum dust at rates of 35 and 60 lb. per acre gave 87 per cent. mortality on dry plants, but only 19 and 36 per cent., respectively, when applied while the plants were wet with dew. Dusts of Pyrocide or pyrethrum powder diluted to contain

approximately 0·2 per cent. pyrethrins were used by growers, with satisfactory results. Tests by J. N. Roney in Texas have shown that weekly applications of a dust containing pyrethrum and sulphur also give excellent control on beet and that arsenical and rotenone dusts are ineffective.

In preliminary trials on spinach, pyrethrum sprays killed all the larvae with which they came in contact, but it was not possible to obtain adequate coverage of the lower surfaces of the leaves. Two proprietary pyrethrum sprays each gave good control of larvae on beet when applied at a pressure of 200 lb. per sq. in.

The measures recommended comprise the destruction of *Chenopodium*, *Amarantus* and related weeds, on which the population of the moth increases before spinach is available ; delaying the planting of the spinach until after 15th September ; and applications at the rate of 35–45 lb. per acre of dusts containing 0·2 per cent. pyrethrins, preferably by means of dusting equipment fitted with a canopy or trailer to ensure that the lower surfaces of the leaves are covered.

Johnson (A. C.), Pinckney (J. S.), Bulger (J. W.) & Phillips (A. M.). **Fumigation of Vetch Seed for the Vetch Bruchid.**—*Circ. U. S. Dep. Agric.* no. 555, 10 pp., 2 refs. Washington, D.C., 1940.

Bruchus brachialis, Fhs., is now distributed on vetch [*Vicia*] throughout the Middle Atlantic seaboard of the United States [*cf.* also *R.A.E.*, A **28** 575], and though quarantine regulations have been established to prevent its transport in vetch seed from this area into some of the western States in which it does not occur, there is a danger of its introduction in seed from the eastern States or in foreign-grown seed, which is imported in considerable quantities, chiefly from Europe. Methods of treating vetch seed to destroy this and other Bruchids without affecting its viability were investigated during 1934–37.

Experiments in 1934 and 1936 established that fumigation with hydrocyanic acid gas under atmospheric or reduced pressure, or with carbon bisulphide under atmospheric pressure [**26** 24] was effective at temperatures not lower than 70°F. During 1936–37, commercial shipments were treated with both fumigants under atmospheric pressure, and complete mortality was obtained in all cases when the temperature of the seed was 70°F. or above and the room, refrigerator car or chamber in which the fumigation was conducted was satisfactorily gas-tight. For carbon bisulphide, the treatment already noticed [**26** 24] was satisfactory, but 4 lb. HCN per 1,000 cu. ft. was found necessary for fumigation at atmospheric pressure. When carbon bisulphide is employed, it should be volatilised within the chamber and agitated where possible for 2 or 3 hours after starting the fumigation ; the load of seed should not exceed 12,000 lb. per 1,000 cu. ft. The sacks of seed should be separated from each other in all cases.

Summary for 1939.—*Insect Pest Surv. Bull.* **19** no. 10 & suppl. pp. 627–650, 5 maps, multigraph. Washington, D.C., U.S. Dep. Agric. Bur. Ent. [1940.]

The principal insect pests that occurred in the United States during 1939 are discussed as in previous years [*R.A.E.*, A **27** 598]. Maps show the distribution of the more important ones.

Infestation by grasshoppers was severe in all States west of the Mississippi River [*cf.* **28** 187, 369], especially in the northern Great Plains. As a result of warm dry weather, the hatching period of *Melanoplus mexicanus*, Sauss., and *M. bivittatus*, Say, in the south began in the second half of April and was generally completed by the end of May; *M. differentialis*, Thos., developed later. Prolonged cold wet weather in late May and June considerably reduced the outbreak in the eastern part of the infested area. Baits were used over about 25 million acres and the general damage was not heavy, though crops in some fields were completely destroyed. Infestation had decreased appreciably in extent and severity by the autumn, and it is considered probable that the outbreak of *Dissosteira longipennis*, Thos., will be practically eliminated after another year of intensive control. Infestation by the Mormon cricket [*Anabrus simplex*, Hald.] was severe over most of its range. Control operations prevented material damage to cultivated crops, but an unusual type of injury occurred on ponderosa pine [*Pinus ponderosa*] growing near its lower limit in one forest, many of the leaders being destroyed in addition to defoliation up to a height of 10–12 ft.

In an attempt to control *Bruchus brachialis*, Fhs., on vetch [*Vicia* spp.] in North Carolina, six shipments of the parasites, *Tetrastichus* sp. and *Triaspis thoracicus*, Curt. [*cf.* **28** 577], were released in two districts. In August, an attempt to rear the latter in large numbers on eggs of *Bruchus* (*Acanthoscelides*) *obtectus*, Say, was begun in Pennsylvania. In the recently discovered infested area in Washington and Oregon [**28** 575], *B. brachialis* was most numerous in one county in each State where self-sown hairy vetch [*Vicia hirsuta*] was abundant in orchard districts. Infestation in the seed-growing areas of western Oregon is still slight and is thought to have originated in neighbouring counties, where vetch was at one time extensively grown as a cover crop, and into which the Bruchid was probably introduced in seed of European origin. An indication of its hibernation quarters was obtained in Oregon when adults were observed on 13th October 1939 beneath mosses and lichens on the trunk and main branches of an oak at the edge of a heavily infested field, but a search for adults in similar situations in south-eastern States was unsuccessful.

Damage to cherries by the codling moth [*Cydia pomonella*, L.] was reported from Utah and to apples by the oriental fruit moth [*Cydia molesta*, Busck] from Indiana. The pear Psyllid [*Psylla pyricola*, Först.] was present in considerable numbers in Washington State in July, and was injurious in some places. In August, the infested area was observed to extend a few miles into Idaho, but it is still a considerable distance from commercial pear-growing areas. Comstock's mealybug [*Pseudococcus comstocki*, Kuw.] attacks apple in three main areas in Virginia, where it is associated with a sooty mould that develops on the fruit; in 1939, infestation was more general than has hitherto been observed. The common asparagus beetle [*Crioceris asparagi*, L.] increased considerably in abundance during 1938 and 1939, and was reported from Alabama and Idaho for the first time in 1938; the twelve-spotted asparagus beetle [*C. duodecimpunctata*, L.], which is rarer and less injurious, was reported for the first time from Minnesota in 1939. The European corn borer [*Pyrausta nubilalis*, Hb.] extended its range in Wisconsin, Pennsylvania, Delaware and Virginia and occurred for the first time in Illinois and North Carolina.

In notes on insect pests of forest trees, increased activity of the western pine beetle (*Dendroctonus brevicomis*, Lec.) is reported from California, Washington and Oregon, while epidemic infestations by *D. monticolae*, Hopk., in sugar pine [*Pinus lambertiana*] in California were the heaviest for 10 years and occurred in areas in which there have recently been no serious outbreaks. *D. pseudotsugae*, Hopk., continues to cause severe loss among Douglas firs [*Pseudotsuga taxifolia*] in the northern Rocky Mountains, and occurred in such large numbers in stands along the southern and central coastal area of Oregon, where trees destroyed by fires in recent years provided breeding grounds, that control is considered to be impracticable. Extensive top and group killing by *Ips oregoni*, Eichh., occurred in pole stands of *P. ponderosa*, both in cut-over reserves and in virgin forest in California; in the past, such outbreaks have been followed by more sustained and serious infestation by *Dendroctonus*. An outbreak of *I. oregoni* on ponderosa pine reproduction in eastern Oregon was the heaviest since 1931. Infestation of *P. ponderosa* by *I. oregoni* and *I. ponderosae*, Swaine, increased in the Black Hills district of South Dakota, and *Ips* spp. and *D. frontalis*, Zimm., became epidemic in loblolly pine [*P. taeda*] in Texas. Infestation by the Black Hills beetle [*D. ponderosae*, Hopk.] on *P. ponderosa* in the central Rocky Mountain region in general declined considerably as a result of control measures, and also, apparently, of natural factors, but is severe in a forest in Utah; a heavy infestation developed in lodgepole pine [*P. contorta*]. Populations of *D. frontalis* were reduced to endemic numbers in the coastal plain of Virginia and North Carolina, but destroyed large areas of shortleaf and pitch pines [*P. echinata* and *P. rigida*] in the mountains of North Carolina and Tennessee and in parts of the Piedmont of North and South Carolina. Infestation by *Hemerocampa pseudotsugata*, McDunn., increased materially on *Pseudotsuga taxifolia* and true fir [*Abies* sp.] in eastern Oregon, and many trees were completely defoliated; in the most heavily infested districts, understory *Pinus ponderosa* was also defoliated. Infestation in 1940 was expected to be light as a result of a decrease in population during the late larval stages. An extensive new outbreak was observed in a forest in Oregon, but defoliation was only partial.

In a section by C. H. Swezey, dealing with pests of sugar-cane in Hawaii, *Anomala orientalis*, Waterh., is stated to have been unimportant in cane-fields, but a light infestation in pineapple growing near cane-fields in one plantation increased to some extent and caused serious damage to ratoon pineapple plants. *Nacoleia* (*Omiodes*) *accepta*, Btlr., became abundant for the first time for several years, but losses were negligible. The affected plantations were in lower and drier situations than those previously attacked [**15** 322]. Increased susceptibility of the newer seedling varieties or increased attractiveness of the cane as a result of methods of culture may have been responsible for the outbreak, which was checked by parasites, notably *Microbracon omiodivorum*, Terry. The unusual outbreaks of *Laphygma exempta*, Wlk. [*cf.* **28** 461] were in some cases correlated with the presence of grasslands adjoining the cane-fields or with insufficient control of grass in the fields; when they subsided, natural enemies, including the egg parasite, *Telenomus nawai*, Ashm., which was artificially distributed, had increased and were abundant. The continued scarcity of *Oxya chinensis*, Thnb., is attributed to the introduced Malayan egg parasite, *Scelio pembertoni*, Timb. [*cf.* **21** 347, etc.].

VAN ZWALUWENBURG (R. H.) & ROSA (J. S.). **Field Movement of Sugar Cane Beetle Borer Adults.**—*Hawaii. Plant. Rec.* **44** no. 1 pp. 3–6. Honolulu, 1940.

Investigations on the movement of adults of *Rhabdocnemis obscura*, Boisd., to and from sugar-cane fields [*cf. R.A.E.* A **27** 90] were begun on Oahu (Hawaii) in February 1939 and continued for a year. Weevils were collected each month in traps of split cane, marked and released at a fixed point. Quick-drying lacquers and aluminium paint were equally satisfactory for marking, but bronze paint did not last long under field conditions. Split-cane traps for the recovery of the weevils were installed monthly at 20 points at the rate of 1 trap per 2 acres and were examined about every fortnight. Of the 10,726 males and 8,499 females released, 1·39 and 1·12 per cent., respectively, were recaptured. Split-cane traps attract the weevils for probably only a few feet, so that recovery at widely scattered traps was largely a matter of chance. The greatest distance a marked weevil was observed to travel was 1,670 ft. ; the individual was of unknown sex and was taken 85 days after its release. Several recoveries were made at distances greater than 1,000 ft., the farthest being a male recaptured 1,240 ft. away after 82 days.

In view of Glick's studies [**28** 80], it is possible that the weevils are sometimes swept to considerable heights by strong winds, and in that way travel distances greater than those recorded. The recaptures of the marked weevils are summarised in a table with reference to the prevailing wind. Their progress is probably aimless, being effected by short erratic flights, and they took less time to travel down-wind and moved further in that direction than up-wind. In a total absence of breeze, 34 weevils released from jars about 7 ft. above the ground flew in all directions, one or two reaching a height of about 30 ft. before disappearing from sight. Of 49 similarly released in a very light breeze, 45 flew directly down-wind, while 4 flew across wind ; most of them flew heavily but more directly than those in still air, while a few flew high at considerable speed on an almost straight course. Neither batch seemed to be influenced by the nearness or absence of cane. The weevils were more active and took flight more readily in bright sunshine than under an overcast sky. The recapture of a weevil 176 days after release supports the view that the adults are long-lived, surviving possibly as much as a year under field conditions.

The larger number of recoveries made down-wind may, however, have been partly due to the fact that all the weevils were released on the edge of a fairly old stand of cane with an open area under taro [*Colocasia*] immediately to the south (leeward) of it. They would find it easier to fly over this open space than through the dense cane growth to the north. Another factor at the beginning of the experiment was the small size of the young cane across the taro patch about 75 yards south of the release station. Weevils rising 6–10 ft. above ground would, in that direction, meet no obstacle to interrupt their flight, as they would in taller cane. The percentages recovered decreased as the year advanced and as the cane grew taller.

The movement of weevils from adjacent fields is mainly responsible for infestation of newly planted areas and ratoon fields. Investigations on one field showed that immediately after the harvest, 3·7 per cent. of the stubble was infested with larvae. During the next five months,

weevils were occasionally observed on the ratooning plants, but it was not until the sixth month, when cane had begun to form, that oviposition began, although adults from the larvae in the stubble must have emerged 2 or 3 months previously. This indicates that infestation is not continued from crop to crop by weevils bred in one particular area and that it is important to clear fields of infested stalks after harvest.

GARLICK (W. G.) & BOYCE (H. R.). **A Note on the Habits of Mature Codling Moth Larvae.**—*Canad. Ent.* **72** no. 4 p. 87. Guelph, 1940.

GARLICK (W. G.). **The Migration of Codling Moth Larvae from one Apple to another.**—*T.c.* p. 87.

In the first note, the authors state that observations throughout the day and night in an apple orchard in Ontario have shown that most of the full-fed larvae of the codling moth [*Cydia pomonella*, L.] leave the apples during darkness, thus diminishing the probable effectiveness of diurnal parasites and predators. The proportion of full-fed larvae to leave the fruit before it fell was high in the case of the first generation and low in the case of the second.

In the second note, the author states that partly grown larvae of *C. pomonella* migrate, almost invariably in darkness, from one fruit to another as much as several feet distant. In 1935, a nearly full-fed larva observed on a branch entered a previously uninfested apple, in which it fed extensively for 6 days and penetrated to the core before leaving to pupate. Further unmistakable evidence of migration was obtained over a period of 2 years, during which, however, the actual process was not observed. Migration began quite early in the season, generally from infested fruits that had failed to develop but had not fallen from the trees ; in some cases, perhaps when the first tunnel became filled with sap, the larva re-entered the same fruit. The damage caused by each larva is increased by this habit, since a partly grown larva is unlikely to be poisoned on entering a fruit, even if it is well covered with spray deposit.

MARTORELL (L. F.). **Some Notes on Forest Entomology.**—*Caribb. Forester* **1** no. 3 pp. 23–24. Rio Piedras, P.R., 1940. (With a Summary in Spanish.)

During the winter of 1939–40, *Cerdana alliodora* growing at sea-level and at high altitudes in two localities in Porto Rico was severely infested by *Monanthia monotropidia*, Stål. Nymphs and adults occurred in large numbers on the lower surfaces of the leaves, causing chlorosis, which was often followed by complete defoliation. Another Tingid, *Corythucha gossypii*, F., which attacks many plants in Porto Rico, including a number of leguminous crops and *Citrus*, was observed in February 1939 on the lower surfaces of leaves of West Indian satinwood (*Zanthoxylum flavum*), which turned yellow and were later shed. Young trees in another district were heavily infested during July, and a second attack developed after the old leaves had been shed and new ones had appeared ; in a third district, the Tingid occurred on nearly every tree of a group of 25, but apparently caused no damage. In March 1940, it severely attacked *Z. monophyllum* in two coastal districts, and in one of them *Z. caribaeum* was also infested, but

sustained no appreciable damage. A large plantation of mahogany (*Swietenia macrophylla*) was found to be infested by *Ischnaspis longirostris*, Sign. ; it occurred chiefly on the lower branches and leaves, on which it was concentrated near the mid-ribs and veins, and caused some defoliation.

Pseudococcus nipae, Mask., is the most injurious pest of *Sterculia apetala*, which is extensively planted along roadsides on the south coast. Infestation generally occurs on the lower surface of the leaves, but the branches and fruits are sometimes attacked, and although the damage, especially to large trees, is often negligible, young trees are sometimes killed. In one district, larvae of the Coccinellids, *Hyperaspis festiva* var. *apicalis*, Weise, and *Scymnillus nunenmacheri*, Sic., were observed attacking the Coccid. In the past, it completely defoliated *Erythrina glauca* each year, but since the introduction of *Cryptolaemus montrouzieri*, Muls., which feeds extensively on it, it is no longer of economic importance on this tree.

Pickles (A.). **Control of the Sugar Cane Froghopper by the Use of Pyrethrum Dust.**—*Proc. agric. Soc. Trin. Tob.* **40** pt. 1 pp. 57–61, 6 figs. Port-of-Spain, 1940.

The sugar-cane froghopper [*Tomaspis saccharina*, Dist.] has been a serious pest of sugar-cane in Trinidad for more than 60 years, and during this time no cheap and entirely effective means of control has been developed. Since preliminary tests showed pyrethrum to be extremely toxic to the adults of the Cercopid [*R.A.E.*, A **26** 404 ; **28** 458], large-scale trials were conducted in 1939. A mixture of pyrethrum (0·5 per cent. pyrethrins) and sulphur, which was found to be as effective as an equal weight of undiluted pyrethrum and less expensive, was used at the rate of 5 lb. of each ingredient per acre, but this rate should be increased for very tall and heavy canes and may be reduced for small ones. The dust was distributed from a tractor-operated dusting machine driven slowly down the cane traces on the windward side of the infested fields, and settled on the canes after slowly drifting over the fields. The machine must be very powerful, as it does not enter the fields ; the one employed in the trials expelled the dust at a speed of 180 miles per hour, and the average rate of work was about 12 acres per hour. Improved results were obtained by delaying the treatment until after 5 p.m., when the adults are active, rain is infrequent, and the wind steady.

Infestation by the second generation was unusually widespread and severe in 1939, and as only limited supplies of pyrethrum were available, a single application was made in the most seriously affected fields ; this was delayed until the nymphal population was declining, in order to obtain the maximum effect, which allowed time for some blight to develop. In all the treated fields the population of adult froghoppers was at least 100 per stool, and, in general, a mortality of 80–99 per cent. was obtained. In some cases, average populations of over 200 were reduced to less than 1. Blight developed to a slight extent, but was serious only in patches where it occurred previous to the treatment, and was considerably more severe in the untreated fields, where the initial adult populations were relatively small. Contrary to expectation, infestation by the third generation was also heavy, but it was appreciably lower in the fields that had been dusted, probably as a result of an unexpected action of the pyrethrum, which

was observed to expel the nymphs from their protective froth and subsequently kill them. Increased supplies of pyrethrum were available, and all the affected fields were dusted before blight developed, as a result of which almost complete control was obtained. There was some evidence that the growth of the canes is stimulated by this treatment. The author suggests that long-range dusting by means of ground equipment might prove successful against pests of other tropical crops, such as cotton.

LLANOS (V. V.). **Observaciones entomológicas sobre el cultivo de algodoń en el Departamento del Atlántico.** [Entomological Observations on the Cultivation of Cotton in the Department of Atlántico, Colombia.]—*Rev. Fac. nac. Agron.* (*Colombia*) **2** no. 6 pp. 593–608. Medellín, 1940.

An account is given of the system on which cotton is grown on the Atlantic coast of Colombia, together with information on the bionomics and control of the chief pests that attack it there. The cotton chiefly grown is of the perennial " native " type ; it reaches a height of about 10 ft. in fertile soil, completes its vegetative cycle in about 9 months and is usually interplanted with other crops, such as maize, cassava and cucurbits. It is rarely harvested for more than two seasons and is then abandoned. Neglected plantations thus provide prolific breeding places for insects that infest cotton, some 50 species of which have been observed by the author, of which those mentioned below were of importance. The most injurious at present is *Sacadodes pyralis*, Dyar [*cf. R.A.E.*, A **26** 403], which occurs on cotton throughout Colombia and attacks the buds, flowers and bolls. The egg, larval and pupal stages last 4–6, 13–18 and 20–25 days, respectively, and females deposit up to 256 eggs. Control measures include soil cultivation to destroy the pupae, and breeding and releasing the Braconid, *Apanteles thurberiae*, Mues. [*cf.* **29** 8], which is an effective endoparasite of the larvae.

Alabama argillacea, Hb. [*cf.* **28** 318] also occurs throughout Colombia and is usually controlled by dusting with calcium arsenate and lime. Considerable natural control is afforded by parasites, of which the most important are unidentified species of *Sarcophaga*, *Phorocera*, *Archytas* and *Rhogas*, and the Chalcids, *Brachymeria comitator*, Wlk., and *B. ovata*, Say.

Platyedra gossypiella, Saund., was first observed attacking cotton on the coast in 1938. Its distribution in Colombia is still restricted to the Departments of Atlántico and Magdalena, and the necessity is emphasised of a campaign to prevent its further spread. Infestation is not yet serious, although it causes a crop loss of up to 40 per cent. in the most highly infested districts. The egg and pupal stages last 4–6 and 10–20 days, and the larval stage generally lasts 20–30 days, but some individuals remain in diapause for over two years. The author recommends the prohibition of movement from infested districts into the interior of Colombia of cotton seed and plant parts or packing material that has contained them, and the installation of equipment for the treatment of cotton seed by heat or fumigation.

Cotton bolls are commonly attacked by various species of *Dysdercus*, the most harmful in Atlántico being *D. fulvoniger*, DeG., in Armero *D. columbicus*, Bloete, and in the Medellín Valley *D. peruvianus*, Guér. They stain the fibre and introduce fungi and bacteria that cause boll

rots. No satisfactory method of control is known. *Aphis gossypii*, Glov., is common on cotton on the Atlantic coast and completes its life-cycle in 8 days. Infestation is most serious in young plantations. This Aphid can be controlled by dusting with a mixture of 6 parts nicotine sulphate and 100 parts lime. Its most important natural enemies in this region are the predacious Coccinellid, *Cycloneda sanguinea*, L., and the Braconid parasite, *Lysiphlebus testaceipes*, Cress. *Laphygma frugiperda*, S. & A., prefers graminaceous plants but also attacks cotton, causing serious injury to young plants by cutting off the leaves and to older ones by feeding in the bolls. It is favoured by the current system of cultivation, but the larvae can be controlled by arsenicals. Alternative food-plants, such as maize, should not be grown near cotton.

The Tenebrionid, *Epitragus aurulentus*, Kirsch, is common on cotton and also attacks maize. On cotton, the adults feed on the leaves, flowers and fruits, causing serious injury to the last two. The larvae feed underground on young or recently germinated plants, destroying the bark at the root-collar. Arsenical dusts should be applied if infestation becomes severe. Older plants are frequently attacked by the mite, *Eriophyes gossypii*, Banks. A list is given of 24 insect pests of cotton that are of secondary importance in this region of Colombia, and in a discussion it is stated that abandoned plantations should in all cases be destroyed to prevent pests breeding in them, and that, from the point of view of pest control, the substitution of a herbaceous cotton for the perennial type is very desirable. A close period could then be enforced and control measures more easily applied.

ALLMAN (S. L.). **Toxicity Tests with the Queensland Fruit Fly, *Strumeta* (*Chaetodacus*) *tryoni* Froggatt.**—*J. Aust. Inst. agric. Sci.* **6** no. 1 pp. 40–44, 10 refs. Sydney, 1940.

Regulations for the control of fruit-flies in New South Wales require the use of either traps or foliage bait-sprays and the collection and destruction of all fallen and infested fruits at intervals not exceeding 3 days. Following experiments by McCarthy [*R.A.E.*, A **13** 641], the bait-spray adopted in 1931 was a mixture of lead arsenate, molasses and fruit syrup. A similar spray is still authorised in the latest regulations, but in 1937 one of sodium fluosilicate and sugar was included as an alternative. Work by J. A. Wright has shown that in the laboratory sodium fluosilicate is more effective against *Ceratitis capitata*, Wied., than lead arsenate and is less injurious to the foliage, but that its effectiveness is reduced by an admixture of molasses [*cf.* also **25** 164, etc.].

Since the flies in some of the original experiments were previously starved and were not allowed access to water, the results, though indicating the order of toxicity of the several poisons, do not show their possible repellent effect or the rapidity of mortality under field conditions. Tests under improved conditions were therefore carried out in New South Wales on adults of *Dacus* (*Strumeta*) *ferrugineus tryoni*, Frogg.; the flies were placed in cages with a sliding glass roof on which the sprays were applied and were allowed access to either water or a 6·25 per cent. solution of sugar. They were bred in the laboratory and given a plentiful supply of food and water until the tests began, when their age ranged from 3 to 7 days. The sprays used contained 2 oz. insecticide and 2½ lb. white sugar in 4 gals. water,

except in the case of lead arsenate, for which the regulation formula (4 oz. lead arsenate and 4 lb. molasses in 4 gals. water) was used. When the flies had access to water but no food, the number of days that had elapsed when a percentage mortality of 50 or over was first recorded was 2 for tartar emetic and sodium fluosilicate, 4 for lead arsenate, and 5 for cryolite, but when sugar solution was provided, it was 2 for tartar emetic, 7 for sodium fluosilicate and lead arsenate, and 8 for cryolite. The first experiment was continued for 5 days and the second for 10, but complete mortality was not obtained in any series. Mortality in the controls was low. Sodium fluosilicate thus seems to be less effective in the presence of an abundant alternative food-supply. Tartar emetic, which maintained its effectiveness under these conditions, produced a more conspicuous deposit that appeared to be hygroscopic and more attractive to the flies. In a similar test with adults of *C. capitata*, however, the difference between tartar emetic and sodium fluosilicate was less striking. The periods required to give 50 per cent. mortality are not excessive in view of the fact that females of *D. f. tryoni* were shown not to oviposit until 7 days after emergence. In the second series of tests, the percentage mortality at the end of 6 days ranged from 79·6 for tartar emetic to 22·7 for cryolite.

In view of the favourable results obtained by other workers [**21** 602 ; **24** 212], experiments were carried out in the laboratory in which fruits were sprayed with insecticides, including lead arsenate, cryolite and a mixture of white oil and nicotine sulphate. When placed in cages with adults of *D. f. tryoni*, all the sprayed fruits became infested, and 50 per cent. mortality of the flies was not obtained until the 15th day with lead arsenate and the 18th with the mixture of white oil and nicotine sulphate, which caused the collapse of many flies that subsequently recovered. Repeated spraying with this mixture might therefore give partial protection, but its use is not recommended and would necessarily be confined to pome fruits.

Tartar emetic can be used with brown sugar and molasses without loss of toxicity, and in preliminary observations caused no more injury to the foliage of apple and peach than sodium fluosilicate, which must be mixed with white sugar only and is less soluble in water.

LINDSAY (E.). **The Biology of the Silverfish,** *Ctenolepisma longicaudata* **Esch. with particular Reference to its feeding Habits.**—*Proc. roy. soc. Victoria* **52** pt. 1 pp. 35–83, 19 figs., 28 refs. Melbourne, 1940.

Ctenolepisma longicaudata, Escherich, which was first recorded from Australia in 1908, is now widely distributed there, particularly in the coastal regions, and it has become a household pest of economic importance. Investigations into its biology, with particular reference to its feeding habits and control, were therefore begun in 1935 ; the experimental methods used are described.

The eggs are laid in crevices in batches of 2–20. The nymphs develop with very little change in form for 2½–3 years. The lengths of the early instars showed considerable variation at a constant temperature of 23°C. [73·4°F.], but gradually increased from 3–4 days for the first to 40–47 days for the thirteenth. Average measurements and characteristic changes in these instars are shown. The adults continue to grow, moult and oviposit for at least 3 years. They feed only during the first part of each stadium, and fertilisation probably occurs

after each ecdysis. Oviposition takes place throughout the summer months. The average number of eggs laid by a female in a year was 56 in the laboratory. The sexes occur in approximately equal numbers.

A detailed account is given of the effects of temperature and humidity on *C. longicaudata*. Under experimental conditions, active feeding and growth began at about 16°C. [60·8°F.] and were greatest at 25°C. [77°F.]. Silverfish exposed continuously to higher temperatures survived for only short periods. Below 11°C. [51·8°F.] development stopped and the insects became torpid. The distribution of *Ctenolepisma* in Australia in pest numbers and its activity during the year can be related to air temperatures. The lethal temperatures were higher in dry than in moist air for exposures of one hour or 15 hours. The longevity of 35 adults kept in dry air averaged 13 days, but since partially dried individuals absorb water from moist air, the effect of short periods in dry air is not cumulative, provided that there are intervening periods in moist air.

The investigations on the feeding habits of the silverfish, which were made over a period of three years, showed that it is a general feeder, eating plant and animal remains as well as commercial goods such as papers, wallpapers and artificial silk. The selective attack on wallpaper and writing and printing paper is due to the palatability of certain constituents. In wallpaper, the palatable materials are the starch and dextrin sizes that are mixed with the pigment to produce the thick coloured layer. In writing paper, the palatable material is the chemical pulp containing degraded celluloses. Papers containing more than 45 per cent. mechanical pulp are not eaten, and the unpalatable materials in this pulp are associated with the " ether extract " fraction. The surface of papers and artificial silk can be rendered unpalatable by spraying with a 1 per cent. solution of tricresylphosphate in a petroleum solvent. Although the silverfish is normally an active feeder, it can survive long periods without food. Of twenty adults kept without food in separate containers, the first died after 21 days and the last three after 252, 276 and 307 days. A diet of cellulose alone was sufficient to support a longer life, three of twenty adults fed only with filter paper living 449, 576 and 636 days, but a more adequate diet was necessary for the nymphs.

The nocturnal habits of the silverfish are important in determining the effectiveness of spraying as a means of control, for the insects sheltering in crevices can seldom be reached by the spray. They are not killed by a mixture of kerosene, lethane [butyl carbitol thiocyanate] and pyrethrum unless they come in contact with the spray droplets on the sprayed surface. The toxic effect of the spray applied on wood lasted for some hours. It is recommended that spraying should be done at night and that the surface round the crevices should be made thoroughly wet for a distance of at least a foot, so that the insects cannot escape from the sprayed area during the first moment of stimulated activity. Examples of *C. longicaudata* suffered a higher mortality than those of *Lepisma saccharina*, L., which was also used in the spray tests, because when they became torpid, they exuded a small drop of fluid from the mouth, which coagulated and fixed the head to the surface, so that even if they recovered they could not free themselves. The lethal effect of paradichlorobenzene and naphthalene depended on the vapour and not on contact with the insect. It is concluded that control measures must be applied at frequent

intervals to protect particular articles and to reduce the numbers of the insects.

Very brief notes on the effect on the silverfish of 65 substances that were tested as repellents are given in a table, but no conclusions are drawn.

MAGEE (C. J. P.). **Transmission of Infectious Chlorosis or Heart-rot of the Banana and its Relationship to Cucumber Mosaic.**—*J. Aust. Inst. agric. Sci.* **6** no. 1 pp. 44–47, 3 figs., 5 refs. Sydney, 1940.

Infectious chlorosis of banana [*cf. R.A.E.*, A **23** 182; **27** 289] was first recorded in New South Wales in 1929, and several sporadic outbreaks of the disease have since occurred. In some years, individual growers in the Richmond River district have experienced considerable losses, when several hundreds of plants have succumbed to the disease during the first year of the establishment of the plantations. This has entailed extensive replanting and, in some instances, the abandonment of parts of the plantations. Outbreaks of the disease are observed mainly during May, June and July, in plants that have been set out the previous year. The chlorotic stage may or may not be accompanied by rotting of the heart leaf and central cylinder, this depending on weather conditions. Plants that do not develop heart-rot enter the mosaic stage and may show this symptom throughout the following spring and summer. The growth of affected plants is retarded, and although bunches are sometimes formed, they are small and unmarketable. After the initial outbreak, natural spread of the disease within a plantation either does not occur or is insignificant.

The Aphid, *Pentalonia nigronervosa*, Coq., was shown by the author in 1930 to transmit the disease, but this has been confirmed only with difficulty, and *P. nigronervosa* is considered to be a capricious vector and unlikely to be of importance under natural conditions. Further studies have shown, however, that the virus is also transmitted by *Macrosiphum solanifolii*, Ashm. (*gei*, auct.), *Aphis* sp. and *A. gossypii*, Glov. Attempts to transmit it by mechanical inoculation within the Cavendish banana and within a seeded *Musa* of undetermined species were unsuccessful. It was transmitted by *A. gossypii* from the Cavendish banana to *Musa ensete* and the seeded *Musa*, and from the latter to the Cavendish and Gros Michel varieties of banana, Manila hemp (*M. textilis*), *Canna indica*, cucumber, squash and tomato. From cucumber and squash, it was readily transmitted by mechanical inoculation to cucumber, squash and tobacco, and from tobacco to cucumber, squash and the seeded *Musa*.

The symptoms caused by the virus in tobacco, cucumber and squash are typical of those caused by *Cucumis* virus 1, of which it is considered to be a strain, and inoculation into young seedlings of the seeded *Musa* of material from cucumber, squash, tomato and silver beet foliage collected in various parts of New South Wales and showing symptoms of mosaic caused symptoms identical with those of infectious chlorosis. On the assumption that the celery virus 1 of Wellman [**22** 577] is identical with *Cucumis* virus 1, the symptoms described by him for banana would be those of infectious chlorosis. It is also probable that the mosaic disease of *M. textilis* in the Philippines [**27** 365] is caused by *Cucumis* virus 1. Infectious chlorosis belongs to a different immunological group from bunchy top, since Cavendish banana plants infected with the former are susceptible to the latter.

Cucumis virus 1 is apparently not endemic in the banana-growing sections of New South Wales, and it is considered that outbreaks of infectious chlorosis are likely to occur only where such crops as cucurbits and tomatos are grown in close proximity to banana during the early stages of the establishment of a plantation. In the Richmond River district, where the disease occurs most frequently, cucurbits, beans, potatoes and tomatos are often interplanted among young bananas. Six species of common weeds taken in a plantation in which infectious chlorosis was spreading were observed to show symptoms resembling mosaic, and the identity of the virus was demonstrated in the case of the interplanted tomatos from among which the weeds were collected.

BRITTIN (G.). **The Validity of the Coccid Genus *Eulecanium* Cockerell.** —*Trans. roy. Soc. N. Z.* **69** pt. 4 pp. 410–412, 4 refs. Wellington, N.Z., 1940.

BRITTIN (G.). **The Life History of *Lecanium* (*Eulecanium*) *persicae* (Fabricius), and Descriptions of the different Instars.**—*T.c.* pp. 413–421, 8 refs.

In the first paper, the author considers that the Coccid genus *Eulecanium* should be regarded as a subgenus of *Lecanium*, and describes its characters.

In the second, he discusses the identity of *L. persicae*, F., in New Zealand, where, owing to the occurrence of slight aberrations among examples from various food-plants and localities, some confusion exists, as a result of which specimens are generally referred to a "*persicae*" group. Since evidence has established that these examples cannot be regarded as food-plant variations and the problem is further complicated by the discovery that the immature stages are identical, the author considers that each variation that gives every indication of being permanent should be named. The form considered by him to be the typical one occurs (though it is not the only form) on grape vine, plum and gooseberry, as well as a number of other plants; the larva, second- and third-instar females and young and old adult females are described. The larvae first appear about the middle of December and disperse over the food-plant, usually becoming fixed on the young shoots or, on grape vines, beneath the loose bark of older limbs, and remaining there until the first ecdysis in the middle of February. A second moult takes place about 2 months later; the first adults appear about the second week in October, and oviposition starts at the end of November.

A form that occurs on *Wistaria* sp. in a district in the North Island is described from the young adult female as *L. persicae spinosum*, subsp. n. It is not the only form on *Wistaria*.

OOSTHUIZEN (M. J.). **The Cowpea Weevil. A serious Pest of Cowpeas in Storage.**—*Fmg in S. Afr.* 1940 repr. no. 12, 1 p. Pretoria, 1940.

Cowpeas are the most important leguminous hay-crop in the summer-rainfall areas of South Africa, and are one of the principal foods of the natives, but the stored seeds are subject to severe damage by larvae of the cowpea "weevil" [*Bruchus chinensis*, L.]. The eggs are laid on the surface of the seeds, and the larvae bore into them and feed in the interior. Heavily infested seed loses up to half its weight in three

months and becomes unfit for planting or human consumption. The adult female lives for about a week in summer and lays up to 90 eggs. The Bruchid multiplies rapidly at this season, and though its development is retarded at the approach of cold weather, there is never a complete cessation of activity during the winter months. The life-cycle from egg to adult lasts about 7 weeks in April–May and about a month in November–January, when the egg, larval and pupal stages are completed in about 5, 17 and 7 days. Up to six generations have been recorded between the end of September and May, and it is possible that a partial seventh may occur during the winter.

Though infestation becomes of importance in storage, it begins in the field, where it is due to adults that fly from stores or hay-stacks and oviposit on the surface of ripening pods and seeds in split pods. To prevent this, infested seed should be treated or destroyed, and all cowpea hay should be fed to stock before the middle of February. Field infestation is reduced by early harvesting, but as flowers and pods are present on the plants at the same time, several pickings may be necessary. The crop should be threshed as soon as possible after it is harvested and the dry seed stored in clean rooms or bins. Infested seed can be treated by heat, and its germinating power is not affected unless treatment is excessive. Small quantities of seed should be spread in thin layers in an oven and heated to a temperature of 120–145°F. for several hours, which destroys all insects and, by drying the seed, renders it less susceptible to fresh infestation. Large quantities can be kiln-dried. In the absence of heating appliances, the seed can be exposed in thin layers on wooden trays or sheets of galvanised iron to the rays of the sun during hot weather. Exposure for one hour in open sunlight at a temperature of about 98°F. in the shade is sufficient.

Experiments have shown that this Bruchid is easily killed by such fumigants as carbon bisulphide or ethylene dichloride. For fumigation with carbon bisulphide, the seeds should be thoroughly dry, as the germination of moist seed is affected. The liquid is placed in a shallow pan or on absorbent material over the cowpeas and used at the rate of 1 lb. per 25 bushels (8 bags) of seed, or 5–8 lb. per 1,000 cu. ft. space. If the depth of the seed exceeds 5 ft., the liquid should also be introduced into the lower portions by means of a pipe having openings at frequent intervals. In recent experiments, stored cowpeas were protected from infestation by mixing with them copper carbonate or lime at the rate of 1 : 500 and 1 : 50 by weight, respectively. Copper carbonate is poisonous to man, and seed mixed with it should not be used as food, but lime does not affect the edibility of cowpeas and can easily be removed from the heap by sifting.

SMEE (C.). **Gelatine Grub** (*Niphadolepis alianta*, **Karsch**).—*Nyasaland Tea Ass. quart. J.* **3** no. 2 pp. 5–7. Blantyre, 1939. [Recd. 1940.]

Most of the information in this paper on the distribution and control of *Niphadolepis alianta*, Karsch, on tea in Nyasaland has already been noticed [*R.A.E.*, A **28** 306]. This Limacodid was also found on coffee and rose bushes, and it is stated that *Gliricidia* and *Derris* are additional possible food-plants. In 1938, when it was present in large numbers at the end of the flushing season, burying the prunings appeared to give some control ; burning them might be more satisfactory [*cf. loc. cit.*]. It is emphasised that control measures should be carried

out very early in the season and that a search for the pest should be made each year. The infestation in Nyasaland is briefly compared with that by other Limacodids in Ceylon.

SMEE (C.). **Leaf-eating Caterpillars on Tea.**—*Nyasaland Tea Ass. quart. J.* **3** no. 4 pp. 1–8. Blantyre, 1939. [Recd. 1940.] **Correction.**—*Op. cit.* **4** no. 1 pp. 1–2.

Owing to the increase in the cultivation of tea in Nyasaland in recent years, favourable conditions are being created for outbreaks of insect pests of this crop, which have been singularly inconspicuous up to the present. In this paper, notes are given on the bionomics of several potential pests of which the larvae feed on the leaves. They include the gelatine grub, *Niphadolepis alianta*, Karsch, of which all stages are described and which is already of considerable economic importance [*cf.* preceding abstract]. This Limacodid occurs throughout Nyasaland, but is common only in Cholo and Mlanje. Five species of nettle grubs (Limacodids of which the larvae, unlike those of *Niphadolepis*, have urticating spines) occur on economic plants (tea, fruit trees and tung [*Aleurites*]) in Nyasaland, but only *Parasa vivida*, Wlk., which attacks tea, coffee, cotton and castor [*Ricinus communis*], appears to be at all common. The eggs are laid in batches on the leaves, and the larvae feed gregariously for most of their lives, consuming the whole substance of the leaf. The older larvae feed singly. Pupation occurs on the branches or stems, and the period usually spent in the cocoon at the beginning of the season appeared to be 25–30 days, though periods of 56–82 days were recorded from the same batch and individuals collected in April 1935 remained in the cocoons as long as 206 and 227 days.

Larvae of the Lymantriid, *Orgyia mixta*, Sn., which skeletonise the leaves, were recently observed at the Mlanje experimental station on pruned tea, which they defoliated within two days. The larvae also attack cotton and *Aleurites*, but are heavily parasitised. Some injury to tea is also caused by *Tortrix dinota*, Meyr., and Psychids, including an unidentified species of *Monda*.

The difficulties of controlling pests in tea plantations by the use of sprays are discussed, and the maintenance of a permanent gang to collect injurious insects is recommended.

SMEE (C.). **Gelatine Grub on Tea in Nyasaland.**—*Nyasaland Tea Ass. quart. J.* **4** nos. 1, 2 & 3 pp. 13–15, 13–18, 11–13, 7 figs. Blantyre, 1939–40.

SMEE (C.). **Further Observations on the Gelatine Grub of Tea** (*Niphadolepis alianta*, Karsch).—*Op. cit.* **5** no. 2 pp. 10–13. 1940.

The first of these papers on *Niphadolepis alianta*, Karsch, infesting tea in Nyasaland is a reprint of one already noticed [*R.A.E.*, A **28** 306]. The second includes more detailed information on the larval diapause in this Limacodid and on the disease attacking the larvae in the Cholo district.

Adults emerge about 17–20 days after the completion of cocoons formed in December–February, but from March onwards this period increases in certain cases, and from a series of cocoons formed in

April and May 1939, 73 per cent. of the adults emerged after 243–284 days. A collection of 4,000 cocoons was made on 14th June 1939; the numbers of moths that emerged in each month from August 1939 to June 1940, inclusive, were 2, 9, 11, 58, 1,244, 1,608, 182, 34, 5, 13 and 1, while about 24 apparently healthy individuals were still in their cocoons in August 1940. From the large numbers that emerged in December and January, the author concludes that larvae would begin to be noticeable in the field at the end of December, and that regular collection of cocoons from April onwards would reduce their numbers considerably.

A "wilt" disease killed the majority of the active larvae in June and July 1939, at which time, however, most of the larvae were in diapause in their cocoons. Observations on several collections showed that about 14 per cent. of the larvae were diseased in March, 88 per cent. in June and July and 70 per cent. in November and December, but only 10·6 per cent. of the cocoons collected in June contained diseased larvae. Over the whole season, only about 12 per cent. of the larvae were killed by the disease, but in 1940 records up to the end of April showed that 48·9 per cent. were dying of it. Insect parasites give little control of the Limacodid; about 8 species have been bred from it, but most of them are comparatively rare. The rate of parasitism was less than 4 per cent. in 1939 and rather less than 6 per cent. in January–April 1940. The total percentage mortality in the larval and cocoon stages was 13 in 1939 and 54 by the end of April 1940, and there was evidence that it might increase still further before the main emergence of adults in December 1940.

In April 1940, considerable numbers of *N. alianta* appeared on a tea estate in Mlanje, and here many active larvae were still present early in August; few cocoons were found at this time, but about 70 per cent. of the larvae had formed cocoons by the middle of August. Only about 12 per cent. of the larvae were parasitised or diseased. A larva of *N. alianta* that was found on the foliage of blue gum [*Eucalyptus*], reached the cocoon stage with no other food.

Report of the agricultural Officer, Mlanje experimental Station 1939. Tea Pests.—*Nyasaland Tea Ass. quart. J.* **5** no. 2 p. 4. Blantyre, 1940.

Notes are given on the incidence of pests of tea in Nyasaland in 1939. In the district of Mlanje, *Helopeltis bergrothi*, Reut., caused considerably more damage than in 1938, and on one estate killed large numbers of young blue gums [*Eucalyptus*] in the vicinity [*cf. R.A.E.*, A **27** 126]. *Orgyia mixta*, Sn., which attacked a large patch of tea at the experimental station, also caused slight damage on an estate in the Cholo district. *Paratetranychus* (*Tetranychus*) *bioculatus*, W.-M., did not become prominent until after the first rains in October [*cf.* **28** 305]. Early spraying appeared to have little or no effect on the incidence of the mite, probably owing to the cessation of clean pruning on many estates and the introduction of extended pruning cycles. It was more widespread in 1939 than ever before, and some evidence was obtained of an extension in the range of conditions under which it may be injurious. Infestation occurred for the first time on an estate that had been heavily shaded until the beginning of 1939, when the shade was removed, and, with the spread of the mite, the question of shade may have to be reconsidered.

SMEE (C.). **Notes on a few Insects attacking Tung Nut Trees.**—*Nyasaland Tea Ass. quart. J.* **5** no. 2 pp. 13–17. Blantyre, 1940.

Tung-nut trees [*Aleurites*] have been attacked by few important insects in Nyasaland, but as the area planted with them increases, it is probable that some indigenous insect may become a pest, and their periodical examination is recommended. Larvae considered to be those of *Heliothis armigera*, Hb., have been found attempting to enter the nuts, and adults of the Bostrychid, *Apate indistincta*, Murr., bore in the trunks and branches, but both are killed by the exudation of gum [*cf. R.A.E.*, A **25** 96]. Branches about 1–2 inches in diameter are sometimes found completely girdled, or even cut through, probably by a large Longicorn ; no eggs or larvae have been found. The leaves are sometimes attacked by adults of *Exora apicipennis*, Jac. [*cf. loc. cit.*] and also by larvae of *Orgyia mixta*, Sn., but the latter appear to do little damage as they are highly parasitised. *Niphadolepis alianta*, Karsch, has occasionally been found in plantations of *Aleurites*, and in the laboratory larvae have been bred to maturity on the leaves.

The leaf-eating adults of the weevil, *Isaniris ater*, Mshl., which are very common on a wide variety of plants, including leguminous crops, cotton and sunflower, occur on *Aleurites* during most of the year, and though they do little damage to well-grown trees, they might defoliate young plants. Much oviposition was observed at the Zomba experimental station up to and during August. At least 50 per cent. of the eggs are parasitised. They are laid in batches of 50 or more under the glued-down tip or edge of a leaf, and the newly hatched larvae drop to the ground through a single circular hole, burrow into the soil and live for some months on vegetable matter. During the cold season, numbers of the adults are sometimes killed by small ants (*Pheidole* sp.) ; an instance of this was observed at Zomba in June and July 1940. At certain times of the year, the weevils occur in clusters on the trees, and it might be possible to collect them in large numbers from small trees.

A few Coccids have been recorded locally from *Aleurites*. An infestation by *Icerya purchasi*, Mask., in the Cholo district in 1936 [**26** 114] appeared to be effectively controlled by *Rodolia* (*Novius*) *obscura*, Weise. *Pulvinaria jacksoni*, Newst., was found in the same district, and a considerable infestation in one plantation was controlled to some extent by an unidentified Coccinellid. An outbreak of *Aspidiotus hederae*, Vall., and other flat scales in 1935–37 [**26** 114] was controlled by the Eulophid, *Aspidiotiphagus lounsburyi*, Berl. & Paoli [**27** 126]. *Aspidiotus hederae* is still fairly prevalent at Zomba and probably occurs in all plantations ; good growth of the trees helps to protect them from infestation. *Pseudococcus adonidum*, L. (*longispinus*, Targ.) occurred in fair numbers on a single tree at Zomba in 1939 and is now established over a fairly wide area, but appears to do little damage.

Tung trees are also attacked and sometimes killed by termites.

DUARTE (A.). **Planos de combate aos gafanhotos.**—*Palestras agron.* **2** pt. 1 pp. 5–16. Lisbon, 1939. [Recd. 1940.]

A brief outline is given of recent progress in locust research, and of the discussions and resolutions with regard to international

cooperation in the control of the three important locusts in Africa adopted by the Fifth International Locust Conference at Brussels in 1938 [*cf. R.A.E.*, A **27** 480–484].

FERREIRA (L.). **A luta contra o *Pseudococcus citri* Risso e o problema geral da luta biológica.** [The Control of *P. citri* and the general Problem of Biological Control.]—*Palestras agron.* **2** pt. 1 pp. 17–47, 22 refs. Lisbon, 1939.

This paper includes a summary of Sweetman's book on the biological control of insects [*R.A.E.*, A **25** 101] and a survey from the world literature of the biology of *Pseudococcus citri*, Risso, and on the various measures that have been directed against it, particularly the use of *Cryptolaemus montrouzieri*, Muls. This Coccinellid was introduced into Portugal from Valencia in 1929 and released against *P. citri*. It has survived in the field and spread somewhat, but has not given complete control.

MACLAGAN (D. S.). **Sunspots and Insect Outbreaks : An Epidemiological Study.**—*Proc. Univ. Durham phil. Soc.* **10** pt. 3 pp. 173–199, 3 figs, 70 refs. Durham, 1940.

The following is taken from the author's summary : An historical study of the outbreaks of several British insects during the last hundred years or so has been made. On epidemiological grounds it has been established that in Britain the frequency of outbreaks is correlated with the periodicity of sunspots. The years of maximum frequency are not exactly synchronous with epochs of sunspot-maxima, although nearly so. The connecting link between sunspots and outbreaks is climatic, the favouring circumstances being probably increased humidity and more intense ultra-violet radiation.

SMALL (T.). **Outbreak of Colorado Beetle in Jersey.**—*Int. Rev. Agric.* **31** no. 5 p. 101M. Rome, 1940.

On 3rd October 1939, 43 adults of *Leptinotarsa decemlineata*, Say, were observed feeding on self-sown potato plants among a crop of mangolds over an area of about 100 sq. yds. in Jersey. No other stages were present, and inspection showed that the beetle did not occur elsewhere in the island. The standard control measures [*cf. R.A.E.*, A **26** 467] were applied.

CHAMBERLAIN (R.). **The Chrysanthemum Midge in Northern Ireland.**—*Agric. Progr.* **16** pt. 2 pp. 202–206. Shrewsbury, 1939. [Recd. 1941.]

Identification of specimens received in December 1937 confirmed the presence of the chrysanthemum midge [*Diarthronomyia chrysanthemi*, Ahlberg (*cf. R.A.E.*, A **28** 111)] on chrysanthemums in glasshouses in a nursery in the Sydenham district of Belfast. It had not previously been recorded in Northern Ireland, and was found to have been introduced with cuttings from a nursery in Chichester (Sussex), where it had been observed in January 1937 on plants imported in 1935 from the United States. The owner of the Sydenham nursery was served with a notice to adopt the measures prescribed by the Ministry of Agriculture for cases recorded in England and Wales [*cf.* **25**

389]. Although all traces of infestation were removed in a relatively short time, treatment with nicotine was continued for five months, and during this time the nursery was kept under constant observation. In May 1938, new plants from the sprayed cuttings were moved to their out-door quarters in the nursery, and routine inspection of these was continued.

In November 1938, a final inspection was made after the plants had been brought into the glasshouse for the winter, and the Cecidomyiid was found to be established on several of them. As the plants had not been infested when transferred out-doors, it was apparent that the midge must have spread outside the nursery before December 1937, although outbreaks previously recorded in Great Britain had in every instance been under glass and there was no evidence that it would live in the open [but *cf.* **28** 299]. Investigations showed that it was definitely established on several premises outside the original outbreak centre, but was confined to an area within half a mile of the nursery. As chrysanthemum is its only food-plant, an attempt was made to eradicate it by starvation. Accordingly, on 20th December 1938, the Chrysanthemum Midge (N. Ireland) Order 1938 was issued, prohibiting the keeping or planting of any living chrysanthemum plant in a scheduled area, or the movement of any such plant out of the area. Compliance with the Order was demonstrated by intensive inspections of all premises in the district. The owner of the nursery dealt solely in the cut-flower trade and had at no time made a practice of selling cuttings, while on the other premises where the presence of the Cecidomyiid was confirmed, chrysanthemums were only grown for private purposes and no plants had been moved. On 12th January 1939, the Importation of Plants (N. Ireland) Order of 1939 was issued, prohibiting the entry of chrysanthemum plants into Northern Ireland from any country outside Ireland, except by licence. A similar Order in respect of importations into Eire was issued simultaneously.

Lloyd (D. C.). **Host Selection by Hymenopterous Parasites of the Moth *Plutella maculipennis* Curtis.**—*Proc. roy. Soc.* (B) **128** no. 853 pp. 451–484, 2 pls., 1 fig., 21 refs. London, 1940.

The following is substantially the author's summary of work on the European parasite complex of *Plutella maculipennis*, Curt., and the possible effect of one parasite on another, in connection with the introduction into New Zealand of *Angitia cerophaga*, Grav. [*cf. R.A.E.*, A **27** 262] and *Thyraeella* (*Diadromus*) *collaris*, Grav. [*cf.* **28** 28] and the probable future introduction of *Apanteles plutellae*, Kurdj.: An investigation is being made of the incidence in the laboratory and field of superparasitism [defined as involving 2 or more individuals of the same species in a host] and multiparasitism [involving individuals of different species in a host] in the primary parasites of *P. maculipennis*. The present paper deals mainly with laboratory experimental work on the three species, *T. collaris*, *Angitia cerophaga* and *Apanteles plutellae*. From the experimental point of view, the problem of multiple parasitism is being regarded as a question of the nature of the oviposition responses of the various parasites. The procedure adopted consists in confining the females in tubes for a fixed time with a given number of hosts and observing their oviposition behaviour and the subsequent development of the immature parasites, to note the effects of competition.

With *T. collaris*, the silken cocoon surrounding the pupa is important in securing maximum oviposition because of the posture adopted by the female in ovipositing. Unparasitised hosts were more acceptable when histogenesis was in the early stages, but hosts parasitised in such stages were usually rejected by subsequent females. This rejection was very well defined in respect of pupae parasitised by *T. collaris* itself or prepupae containing advanced stages of *Angitia cerophaga* and was exercised when such hosts were given to the females for numerous brief exposures. Superparasitism in pupae and prepupae occurred only in cases where the host contained recently deposited eggs ; multiparasitism obtained when the *Thyraeella* female encountered prepupae containing early instars of *A. cerophaga*, but oviposition in these conditions was restricted. Experiments suggest that feeding on the host contents is necessary for the full development of the gonads.

A. cerophaga will attack host larvae in any instar and also occasionally prepupae in cocoons. The females usually rejected larvae containing eggs or first and second instars of their own species when unparasitised hosts were available ; when parasitised hosts only were given to them, oviposition was limited. They also showed an ability to distinguish between unparasitised host larvae and those containing eggs of *Apanteles plutellae*. The latter oviposited in host larvae in the first three instars and tended to avoid parasitising hosts containing immature stages of its own species or of *Angitia cerophaga*.

Elimination of supernumerary larvae in superparasitism by *T. collaris* was usually by combat in the first and second instars. When it was present in a prepupa with an early instar of *Angitia*, neither species survived. Suppression of excess larvae in superparasitism by *Angitia* and *Apanteles* was by physiological inhibition in the first instar. This also occurred when both species were found in one host, but neither species appeared intrinsically superior if the eggs were laid within a short interval.

Some data obtained in 1939 on field parasitism in the first generation of the host in North Holland, where all its important parasites occur, are included. The details for superparasitism and multiparasitism support the laboratory experiments. The relation of the findings to the biological control practice of introducing several primary parasites of a given pest is briefly examined.

WATSON (M. A.). **Studies on the Transmission of Sugar-beet Yellows Virus by the Aphis,** *Myzus persicae* **(Sulz.).**—*Proc. roy. Soc.* (B) **128** no. 853 pp. 535–552, 12 refs. London, 1940.

The following is substantially the author's summary of laboratory investigations on the relationship between *Myzus persicae*, Sulz., and the virus of sugar-beet yellows, strains of which were obtained from sugar-beet in Holland and from sugar-beet and mangold in England, and which appears to belong to the persistent type of virus [*cf. R.A.E.*, A **29** 26], since it is not transmissible mechanically by any of the usual methods and the vector remains infective for several days after removal from the source of infection : The efficiency of *M. persicae* in transmitting the virus increased greatly with increasing feeding time on the infected plants. Infection was produced on a succession of healthy plants for 1, 2 or 3 days depending on the length of the infection feeding time. The infectivity of the vectors increased with increasing feeding time on the healthy plants undergoing infection, and decreased

with increasing feeding time on healthy plants prior to those on which the infection trial was made. There was no clearly defined " incubation period " of the virus in the vector, below which no insect could cause infection, but there was variation in the time between cessation of infection feeding of the Aphid and the initiation of infection in the healthy plants.

The relations of this virus with its vector differ from those of the viruses already described as non-persistent [*cf.* **28** 301 ; **29** 27]. For the latter viruses, infectivity is lost by *M. persicae* soon after cessation of infection feeding ; after fasting, the vectors become optimally infective almost immediately on penetrating infected tissues of the leaf. Their infectivity decreases with increasing feeding time on the infected plants, and increases only slightly with increasing feeding time on the healthy plants.

The behaviour of sugar-beet yellows virus is compared with that of curly-top virus of sugar-beet, in which infectivity also persists for an indefinite period in the vector (*Eutettix tenellus*, Baker) and increases with increasing feeding time on infected and healthy plants [**20** 431].

SIMMONDS (F. J.). **A Record of *Melittobia acasta* Walk. (Hym., Eulophidae) from a Lepidopterous Host.**—*Ent. mon. Mag.* **76** no. 913 p. 137. London, 1940.

In the autumn of 1939, 4 males and 7 females of the Eulophid, *Melittobia acasta*, Wlk., and 3 males and 13 females of the Pteromalid, *Dibrachys affinis*, Masi, were bred from a pupa of *Cydia pomonella*, L., found under the bark of an apple tree in southern France. The usual hosts of *M. acasta* are Hymenoptera and Tachinids. Records of its being reared from Lepidoptera are quoted from the literature, but in most of these cases it was probably hyperparasitic. The conditions formulated in a paper already noticed [*R.A.E.*, A **15** 338] for parasitism by *M. acasta*, which are recapitulated, would exclude Lepidopterous pupae as hosts, and it is considered therefore that the *Cydia* pupa was first attacked by the Pteromalid, and that the development of the larvae broke down the host tissue and created air spaces within the pupal case, which rendered the pupa a suitable host for *M. acasta*.

STAEHELIN (M.) & BOVEY (P.). **La lutte contre le Carpocapse et la Tavelure des pommiers et poiriers, en Suisse romande. Observations et essais effectués de 1933–1938.**—*Landw. Jb. Schweiz* **54** pt. 6 pp. 635–680, 8 figs., 7 refs. Berne, 1940.

Observations on adult flight and the occurrence of a second generation of *Cydia* (*Laspeyresia*) *pomonella*, L., in western Switzerland [*cf. R.A.E.*, A **21** 297 ; **22** 432] were continued in 1933–38, and a detailed account of the results is given in the first part of this paper. Traps were set up in orchards in a number of localities on the shores of Lake Geneva, in the Valais and on the plateau of Vaud, and were examined daily from May to the beginning of September. The results for each locality are given in graphs ; they showed in general that the adults of the overwintered generation appear rather late in relation to the blossoming of apple and pear and that they may be present for 2–3 months [*cf.* **23** 599]. The beginning of the flight period and its duration varied considerably from year to year and from locality to locality. A partial second generation occurred in most districts,

particularly in the Valais, where the larvae cause considerable injury in August to apples of late varieties. In all cases, larvae that gave rise to adults in the same summer were full-fed by the beginning of August and those that left the fruits after this date entered hibernation. The adults of the summer generation generally emerge in early August and mingle with those of the overwintered generation. Their presence does not prolong the flight period, since even in districts in which a second generation does not occur, adults were taken as late as September. The second generation is of less economic importance on Lake Geneva and is insignificant on the plateau of Vaud. A table shows the earliest dates on which injury to the fruits could have occurred in the various localities in the 6 years. Fruit is not infested before the beginning of June in most districts or before 25th May in the Valais.

Experiments on control were also carried out in apple orchards in 1933–38, the results being given in detail in tables and discussed at some length. Preliminary investigations showed that the programme usually followed in Switzerland, consisting of two applications of an arsenical spray, one at petal fall and a second 2–3 weeks later, is insufficient in years that are favourable to the moth. It is concluded from the later work that on early varieties the calyx spray should be followed by a second application 10–12 days after the beginning of adult flight, and that on late varieties a third should be applied 2–3 weeks after the second. If a fairly abundant second generation renders necessary a late spray in August, ovicides, such as nicotine or white oil, should be used.

Nascent aluminium arsenate [*cf.* **28** 503] containing 19–20 per cent. As_2O_5 and used at 0·5 per cent. strength proved as effective as lead arsenate paste at 1 per cent., while a pure diplumbic lead arsenate containing 30 per cent. As_2O_5 at 0·5 per cent. strength was superior. The effectiveness of an arsenical spray was prolonged by mixing it with a white oil, but not more than 1 per cent. of an oil of low viscosity should be used. A proprietary preparation with a cryolite base gave good results, but was inferior to the arsenicals. It is considered that although fluorine compounds are less toxic to the larvae, they are of great use against *C. pomonella* in gardens and can be applied late in the season when arsenicals are not permissible.

Schneider-Orelli (O.). **Die weisswollige Fichtenstammlaus** *Pineus* (*Chermes*) *pineoides* **Cholodk.** [The Spruce Trunk Aphid, *C. pineoides*.]—*Schweiz. Z. Forstw.* 1940 no. 9 repr. 8 pp., 2 pls., 2 figs., 13 refs. Berne, 1940.

Descriptions are given of the female and young larva of *Chermes* (*Pineus*) *pineoides*, Cholodk., together with characters distinguishing these forms from those of *C.* (*P.*) *strobi*, Htg. *C. pineoides* is anholocyclic on spruce and does not produce winged forms. It has not been recorded in the literature from forests in Switzerland, but the author has often observed it on trunks of spruce, though not on young spruce, and describes an infestation that occurred near Zürich on a spruce trunk 16 ins. in diameter uprooted by wind. Owing to its restricted capacity for increase, *C. pineoides* is of very much less practical importance than *C. nordmannianae*, Eckstein (*Dreyfusia nüsslini*, Börner) [*R.A.E.*, A **27** 517]. It is well protected under the bark scales, and in an experiment in 1940, a derris dust gave unsatisfactory control.

LÜHMANN [M.]. **Beiträge zur Biologie der Chrysomeliden. 4. Beobachtungen an** *Galeruca tanaceti* **Lin.** [Observations on *G. tanaceti*.]—*Ent. Bl.* **35** pt. 2 pp. 91–95, 3 figs. Krefeld, 1939. [Recd. 1941.]

An account is given of the bionomics of *Galeruca tanaceti*, L., in Germany. Both adults and larvae are polyphagous, and occasionally attack cultivated plants, but except in periods of overpopulation, they live almost exclusively on *Achillea millefolium* and *Cerastium arvense*, and are therefore usually found on the edges of roads, fields, etc. Oviposition takes place from about mid-September to the beginning of November, the adults surviving until the advent of severe night frosts. The eggs are laid in batches of 20–30, cemented together, usually on plants that are taller than the surrounding ones. The egg, larva and pupal cocoon are briefly described. The larvae hatch at about the end of April and are more injurious than the adults, but cause serious damage only in seasons following autumns in which the weather favours the adults in a locality already densely populated. They are then so numerous that they are driven by hunger to cultivated plants such as radish, cabbage, turnip and rhubarb. The attack lasts only a few weeks, and rarely recurs in the following year. If the adults are abundant near fields, the egg-masses can subsequently be destroyed by ploughing up the edges of the fields or by burning the vegetation there.

MAERCKS (H.). **Untersuchungen zur Biologie und Bekämpfung schädlicher Tipuliden.** [Investigations on the Biology and Control of injurious Tipulids.]—*Arb. physiol. angew. Ent. Berl.* **6** no. 3 pp. 222–257, 4 figs., 17 refs. Berlin, 1939. [Recd. 1941.]

Most of the investigations described in this paper on the habits and control of Tipulid larvae in grasslands, pastures and cereal fields in the moorland districts of north-western Germany have already been noticed from a briefer account [*R.A.E.*, A **27** 519]. Injury by them was particularly serious in 1937, when clover, grasses and rye were attacked. The distribution of the various species is shown on a map and discussed. Material bred for identification showed that in 1938 *Tipula paludosa*, Mg., was the commonest species in the Weser-Ems region. *T. oleracea*, L., was less abundant, and *T. czizeki*, de Jong, *T. vernalis*, Mg., and *Nephrotoma* (*Pales*) *maculata*, Mg., were sporadic. *N. maculata* was the most numerous in the marshlands of the coastal regions, *T. paludosa* being scanty. Field catches in the Weser-Ems region showed that the flight period of *T. paludosa* began on 7th August, in hot, dry weather; only males were taken. Adults of *T. czizeki* and *T. pagana*, Mg., were very numerous in the autumn of 1937.

EHRENHARDT (H.). **Experimentelle Untersuchungen und Freilandbeobachtungen über den Einfluss von Kälte und Eis auf die Blutlaus.** [Experimental Investigations and Field Observations on the Influence of Cold and Ice on the Woolly Aphis.]—*Arb. physiol. angew. Ent. Berl.* **6** no. 3 pp. 257–285, 2 figs. Berlin, 1939. [Recd. 1941.]

Since 1930, the woolly apple aphis [*Eriosoma lanigerum*, Hsm.] has caused increasing losses to apple growers in the district of the lower Elbe. It has been shown [*R.A.E.*, A **23** 355] that the Aphid is

fairly resistant to low temperatures, but as little is known of the effect on it of ice, which frequently occurs in winter in this district, owing to the moist climate, though extreme temperatures are rare, investigations were carried out in 1937–39. The experimental material was either bred in a greenhouse on apple plants in pots or collected in the field. Larvae in various stages and adults were subjected for periods of 24 hours in February 1938 to temperatures of about −2 and −15°C. [28·4 and 5°F.], those from the greenhouse being kept for 2 hours at about −1·5°C. [29·3°F.] before being transferred to the lower temperature. In one series of tests, the Aphids were sprayed with water until they were completely enclosed in ice. In both series, the percentage mortalities were greater among Aphids bred in the greenhouse, and in general they increased with increasing age, the adults being less resistant than the young larvae. When larvae and adults are considered together, the percentage mortalities averaged 5·2 and 18·9 for Aphids taken in the field and subjected to dry cold at the two temperatures and 15·7 and 73·2 for greenhouse Aphids. For those enclosed in ice the corresponding percentages were 26·8, 90·3, 46 and 96·8. The percentage mortality of adults subjected to dry cold in no case exceeded 77, but all those kept in ice at −15°C. died, as well as all the older larvae from the greenhouse.

In seeking for the causes of the differences in sensitivity, it was found that the Aphids collected in the field in winter were on an average smaller and contained fewer eggs and embryos than the corresponding stages of Aphids in the greenhouse. It is considered that these winter Aphids represent a form physiologically adapted to the cold season. The wax produced in summer by the Aphids affords no protection against cold since most of it disappears in the course of the winter.

Field observations confirmed the experimental results. Even in the relatively mild winter of 1937–38 there was a noticeable decrease in Aphid abundance. The decrease was much quicker and greater in the winter of 1938–39, when frosts lasted longer and were more severe.

As the sensitivity to cold was much greater in Aphids in the Lower Elbe districts than that recorded in Naumburg [**18** 3], it is suggested that there are local races differing in physiological reaction.

SPEYER (W.). **Biologie und Bekämpfung des Apfelblütenstechers *Anthonomus pomorum* L.** [The Biology and Control of the Apple Blossom Weevil.]—*Arb. physiol. angew. Ent. Berl.* **6** no. 3 pp. 286–308, 4 figs., 3 pp. refs. Berlin, 1939. [Recd. 1941.]

The author discusses from his own observations and those of other workers in Germany certain aspects of the bionomics and control of *Anthonomus pomorum*, L., on apple. While it was thought a few years ago that this weevil is not injurious [*R.A.E.*, A **24** 740, etc.], it is now generally recognised that it may cause serious loss if it is abundant in seasons when apple blossom is scarce [*cf.* **27** 298].

The adults are able to fly, and do so in spring when the temperature reaches 14–15°C. [57·2–59°F.], provided that there is occasional sunshine; as these conditions are not uncommon during the period when the weevils abandon their winter quarters, banding the trees affords only partial protection. The abundance of the weevils in spring is dependent on the availability of suitable hibernation sites, since weevils that are insufficiently protected are killed by weather

conditions or disease. The most favoured sites are cracks and hollows in rough bark. No overwintering adults were found in the soil. Differences in the posture of dead and hibernating adults are described.

Some control of the weevils is given by fungous diseases. Parasitism of the larvae by *Pimpla pomorum*, Ratz., is variable. The Braconid parasite of the adults [*cf.* **21** 581], which has been identified as *Syrrhizus delusorius*, Först., is considered to be of greater importance; the percentage parasitism by it ranged up to 25. An account is given of laboratory tests in March 1939 on the effect of various sprays and dusts on adults of *A. pomorum*, and also on those of *Adalia* (*Coccinella*) *bipunctata*, L., *Phyllodecta vitellinae*, L., *P. vulgatissima*, L., and spiders of the genus *Clubiona*, all of which also overwinter in the bark. It is concluded from them that the tar distillates known as Baumspritzmittel applied immediately prior to the opening of the buds, or a pyrethrum spray applied during and shortly after opening, are effective against *A. pomorum* [but *cf.* **27** 298]; the other beetles were more resistant. Dinitro-ortho-cresol in dusts and sprays also gave good mortality of the weevils, but is not recommended owing to the precautions necessary in applying it. Dusts containing quassia were ineffective.

HADERSOLD (O.). **Ergebnisse von Parasiten-Zuchten der Zweigstelle Stade der Biologischen Reichsanstalt für Land- u. Forstwirtschaft.** [The Results of Rearing Parasites at the Stade Branch of the National Biological Institute for Agriculture and Forestry.]—*Arb. physiol. angew. Ent. Berl.* **6** no. 3 pp. 311–315, **7** refs. Berlin, 1939. [Recd. 1941.]

Records are given of a Cecidomyiid and 11 Tachinids bred since 1926 from insects attacking fruit and other trees and plants at Stade [*cf. R.A.E.*, A **27** 352, etc.].

SELLKE (K.) & VON WINNING (E.). **Zuchtversuche mit der Raubwanze *Podisus maculiventris* Say (Pentatomidae; Asopinae) unter Berücksichtigung ihrer Eignung als natürlicher Feind des Kartoffelkäfers (*Leptinotarsa decemlineata* Say).** [Breeding Experiments with the predacious Bug, *P. maculiventris*, with Reference to its Suitability as a natural Enemy of the Potato Beetle.]—*Arb. physiol. angew. Ent. Berl.* **6** no. 4 pp. 329–342, 5 figs., 4 refs. Berlin, 1939. [Recd. 1941.]

An account is given of the laboratory technique by which the American predacious Pentatomid, *Podisus maculiventris*, Say, was bred in Berlin in 1936-39 to ascertain its possible value in Germany against *Leptinotarsa decemlineata*, Say, on potato. The colony was reared from eggs obtained from Bordeaux.

From consideration of the data obtained, which are recorded in detail, it is considered unlikely that *P. maculiventris* would give any appreciable control of *Leptinotarsa* under the climatic conditions of Germany, since very few adults survived the winter in open-air cages, and there was a high mortality among first-instar nymphs. The adults apparently leave their winter quarters earlier than *Leptinotarsa* and are likely to find insufficient food in early spring, and both nymphs and adults are polyphagous. The indigenous Pentatomids, *Picromerus bidens*, L., *Auriga* (*Arma*) *custos*, F., *Troilus luridus*, F., and *Pinthaeus sanguinipes*, F., are also unlikely to be of any value for the control of the beetle.

Sy (M.). **Ueber die zweite Generation des Apfelwicklers und ihre Bedeutung für die Bekämpfung.** [On the second Generation of *Cydia pomonella* and its Significance for Control.]—*Arb. physiol. angew. Ent. Berl.* **6** no. 4 pp. 343–350, 9 refs. Berlin, 1939. [Recd. 1941.]

Data based on laboratory breeding and weekly examinations of trap-bands are given on the occurrence in the region of Berlin in 1939 of a second generation of *Cydia pomonella*, L., on apple. The results are compared with those obtained in 1934–36 at Landsberg [*cf. R.A.E.*, A **25** 527]. The percentage of first-generation larvae that gave rise to moths during the summer ranged from 100 and 83 during 6th–13th and 13th–19th July, respectively, to 4 during 2nd–9th August, pupae were observed until the end of August, and adult emergence continued from 28th July to 30th August, the peak lasting from 9th to 20th. The fact that this peak occurred about a week later than at Landsberg is ascribed to cold weather in spring having retarded the emergence of the adults of the overwintered generation, which delayed that of the summer generation.

The recorded occurrence over most of Germany of a second generation of the moth greatly complicates the problem of control. It would not be economic to continue spraying with arsenicals until the end of the flight period, that is, until mid-August at least, owing to the cost of removing arsenical residues from the fruit, and it is therefore suggested that control measures should be concentrated on the first-generation larvae in an attempt to reduce the size of the second generation. The value of the generally recommended calyx spray, which is applied 2–4 weeks before the first larvae hatch, is doubtful, and investigations on the correct dates for spraying are urgently required. In the meantime, it is suggested that use might be made of chemically treated bands against the larvae. These have given good results in the United States, but have so far not been employed in Germany.

Sachtleben (H.). **Ein neuer Parasit des Maiszünslers : *Polyodaspis ruficornis* Macq. (Diptera : Chloropidae).** [*P. ruficornis*, a new Parasite of the Maize Pyralid.]—*Arb. physiol. angew. Ent. Berl.* **6** no. 4 pp. 365–366, 4 refs. Berlin, 1939. [Recd. 1941.]

In the course of investigations in 1929 and 1930 on the parasites of *Pyrausta nubilalis*, Hb., in Bulgaria, Rumania and Hungary [*cf. R.A.E.*, A **19** 147, 151], puparia and, in some cases, larvae of the Chloropid, *Polyodaspis ruficornis*, Macq., were found together with dead or paralysed larvae of the Pyralid in maize stalks in all three countries. In view of the record of this Chloropid parasitising *Hoplocampa* [**15** 387] and its similarity to *P. endogena*, de Meij. [**27** 94], it is concluded that it is also a parasite of *Pyrausta nubilalis*.

[Vukasović (P.).] **Вукасовић (П.). Contribution to phytopathological Studies in Connection with the Status of Agriculture in the Environs of Mostar, Shiroki Brieg, Blagai and Buna.** [*In Serbian.*]—*Glasn. hig. Zav.* **23** no. 1 pp. 58–81, 8 figs., 1 ref. Belgrade, 1940.

In the course of investigations on the state of agriculture in the Province of Herzegovina, western Jugoslavia, in the autumn of 1936, a survey was made of the pests and diseases of various crops in the

district of Mostar. Insect pests of importance included *Gryllotalpa gryllotalpa*, L., on potatoes, *Pyrausta nubilalis*, Hb., on maize, *Bruchus* (*Bruchidius*) *obtectus*, Say, on beans in the field and in store, *Rhagoletis cerasi*, L., on cherries, *Hyalopterus arundinis*, F. (*pruni*, F.) on peaches, and *Capnodis tenebrionis*, L., on various stone-fruit trees.

[Milisavl'ević (D.).] **Милисављевић (Д.). Le vol du Carpocapse en 1937 et les résultats des essais de traitement.** [*In Serbian.*]—*Arh. Min. Pol'oprivr.* **7** no. 17 pp. 128–136, 7 refs. Belgrade, 1940. (With a Summary in French.)

Cydia (*Carpocapsa*) *pomonella*, L., is an important pest of apples and pears throughout Jugoslavia, and as climatic conditions vary considerably in different parts of the country, its seasonal occurrence and the number of generations vary accordingly. In the district of Vršac, in the north-east, insecticides are usually applied against it in May, during the four weeks after the flowering period ends. To test the correctness of this timing and to ascertain the flight period of the adults, bait-pans were kept in operation in an orchard from mid-April to the end of September in 1936 and 1937, the moths caught being counted daily. The results showed that there is normally one complete generation in the year ; a second generation may sometimes occur, but it is of no economic importance. Moths were caught almost uninterruptedly from 2nd or 3rd June till 5th September, and were most numerous from 18th to 31st July. It therefore appears that spraying in May is unnecessary, and this was confirmed in small-scale experiments in which apple trees were sprayed with various arsenicals, including lead arsenate (3–4 lb. per 100 gals.). Applications in May, before the adults emerged, were of no value, and insufficient control was afforded by two applications of lead arsenate, one on 9th June and the other on 2nd July. The best result was obtained when applications on these two dates were followed by a third on 26th July (during the peak of adult flight), which resulted in 84·9–86·1 per cent. sound fruits, compared with only 22 on untreated trees. When pears were sprayed with lead arsenate (4 lb. per 100 gals.) on 26th July, the percentage of sound fruits was 63·1–69·6, compared with a maximum of 42·3 in controls.

[Vukasović (P.).] **Вукасовић (П.). Contribution à l'étude de *Sitotroga cerealella* Ol.** [*In Serbian.*]—*Arh. Min. Pol'oprivr.* **7** no. 18 pp. 3–49, 2 figs., 7 refs. Belgrade, 1940. (With a Summary in French.)

A detailed account is given of laboratory investigations in Belgrade on the bionomics of *Sitotroga cerealella*, Ol., which is an important pest of stored grain in Jugoslavia and, in the south of the country, also attacks the growing ears of cereals in the field. The female genitalia are described. Reared females paired immediately after emergence, and at 27°C. [80·6°F.] most of them began to oviposit within 24 hours of pairing. The oviposition period lasted 2–9 days and was not related to the total number of eggs deposited. The numbers of eggs laid daily varied greatly, but were larger at the beginning than at the end of the oviposition period. The average numbers of eggs deposited daily were 37, 31 and 30 for females from larvae reared on maize, barley and soft wheat, respectively. The eggs were laid either singly

or in batches, the number and size of which bore no relation to the duration of the oviposition period, the total number of eggs deposited, or the number laid daily.

Great variations were observed in the fecundity of females of a single strain or generation and also in the viability of the resulting eggs. Females reared on barley, soft wheat and maize laid, respectively, 15–178, 30–170 and 169–284 eggs each, and the percentage mortality of the latter ranged from 7·7 to 52, 0 to 84 and 5·4 to 18·2, and averaged 29, 18·7 and 10·7. Owing to the varying mortality in the egg stage, females that laid larger numbers of eggs than others sometimes gave rise to fewer larvae. The percentage mortality among the eggs increased as the batches decreased in size, and averaged 18, 19, 33·4 and 36·6, respectively, in those of 31–40, 10–30 and 7 eggs and among eggs laid singly. The numbers of adult progeny per female ranged from 13 to 119 and averaged 122, 107, 48, 46·5 and 37 for females from larvae reared on barley, soft wheat, sterilised barley, maize and sterilised soft wheat, respectively. It is concluded from these figures that maize, which had a favourable effect on the fecundity of females and the viability of their eggs, does not favour larval survival or ensure a large number of descendants. In experiments in which batches of larvae were reared on soft wheat, barley, rye or maize, the percentage survival of the larvae was highest on barley (51·2 for untreated and 35·8 for sterilised grain) and lowest on maize (24·3 and 14·1, respectively). The high rate of larval mortality on maize was probably due to the hardness of the grains [*cf. R.A.E.*, A **21** 416].

The duration of the development of a generation was dependent on larval nutrition ; at a mean temperature of about 27°C., it averaged 29, 30, 32, 34, 39 and 49 days on soft wheat, hard wheat, sterilised barley, rye, maize and sterilised wheat, respectively. Larvae from a single batch of eggs reared at a mean temperature of 25–27°C. [77–80·6°F.], completed their development in 28 days on soft wheat, 31 on barley, 34 on maize and 36 on rye. Variations, sometimes of as much as several weeks, occurred, however, in the duration of development of individuals, even those resulting from a single female ; they were most marked at low temperatures and under unfavourable conditions of larval nutrition. The average duration of the life-cycle from egg to adult was 113 days at a mean temperature of rather less than 17°C. [62·6°F.], 85–95 days at 18°C. [64·4°F.] and 36 days at 27·6°C. [81·68°F.].

Males and females were approximately equal in numbers, but the former emerged somewhat earlier and usually lived rather longer. In general, the adults survived for rather more than a week ; their longevity was slightly affected by temperature and the food on which they had been reared and very considerably by humidity, high relative humidities being favourable.

RIVNAY (E.). **Studies in the Biology and Control of** *Pseudococcus comstocki* **Kuwana on** *Citrus* **in Palestine.**— *Hadar* **12** no. 7 pp. 197–201, 3 figs. 1939. (Abstr. in *Exp. Sta. Rec.* **82** no. 5 p. 651. Washington, D.C., 1940.)

In studies on the use of oils containing certain emulsifying agents for the control of *Pseudococcus comstocki*, Kuw., on *Citrus* in Palestine, a thiocyanate compound and soap gave the best mortality of all

the substances tested. The residual effect of the oil upon larvae was found to persist for a certain period. An attempt to control the Coccid by the liberation of the Hemerobiid, *Sympherobius amicus*, Nav., was unsuccessful.

[Beeson (C. F. C.).] **Entomological Branch.**—*Rep. For. Res. Inst. India 1938–39* pp. 33–42. Dehra Dun, Forest Research Institute, 1940.

Notes are given on entomological work carried out in India by the Forest Research Institute in 1938–39. Outbreaks of *Ectropis deodarae*, Prout, which defoliates deodar (*Cedrus deodara*), have recurred since 1934 in pure, isolated, heavily grazed blocks in the Simla hills; studies made in June–July 1938 on the effect of grazing on the ecology of this Geometrid showed that terracing due to cattle tracks creates conditions unfavourable for the destruction of the pupating larvae by ants and the predacious Carabid, *Calosoma beesoni*, Andr., and that the disappearance of the normal undergrowth has an adverse effect on parasitism, the ratio of pupae of *Ectropis* to parasite puparia and cocoons being ten times as high in such forests as in areas with a better soil flora. Only direct methods of control, such as the use of adhesive bands, are therefore possible in grazed forests.

A survey of the parasites and predators of defoliators of shisham (*Dalbergia sissoo*) showed that in the Punjab the larvae of *Plecoptera reflexa*, Gn., were parasitised by *Disophrys sissoo*, Wlkn., *Tachina* (*Eutachina*) *civiloides*, Baranov, *Microgaster plecopterae*, Wlkn., *Podomyia setosa*, Dol., *Zenillia* (*Exorista*) *picta*, Baranov [*cf. R.A.E.*, A **27** 612], unidentified species of *Euplectrus* and *Enicospilus* and an unidentified Tachinid, and the pupae by *Brachymeria nursei* [?*Oncochalcis nursei*, Cam.]. Additional parasites that occurred elsewhere are *Z.* (*Carcelia*) *thermophila*, Wied., two species of *Apanteles* and one of *Megarhogas*. Larval parasitism reached 50 per cent. in the northern plantations between April and August and 25 per cent. in the southern ones towards the end of the defoliation season, and pupal parasitism nearly 50 per cent. in June and July. Parasites of the larvae and pupae of *Dichomeris eridantis*, Meyr., in the Punjab comprised *Cadurcia vanderwulpi*, Baranov, *Camptothlipsis furtifica*, Wlkn., *Meteorus dichomeridis*, Wlkn., *Paralitomastix varicornis*, Nees, *Phanerotoma hendecasiella*, Cam., and species of *Apanteles*, *Brachymeria*, *Chalcis* and *Microbracon*. In July 1938, puparia of *T. civiloides* were transferred to Miranpur, and adults of *Euplectrus* and *D. sissoo*, and of the Carabids, *Anthia sexguttata*, F., and *Calosoma maderae indicum*, Hope, were liberated there.

The examination of experimental plots of cardamom (*Elettaria cardamomum* var. *major*) in December 1938 showed that the Scolytid, *Poecilips* (*Thamnurgides*) *cardamomi*, Schauf., did not cause the widespread reduction in yield of berries commonly attributed to it. Tests with 4,000 seeds of *Lantana* showed that the viability of both healthy seeds and those attacked by *Agromyza* (*Ophiomyia*) *lantanae*, Frogg. [*cf.* **27** 612] was very low; it is concluded that the weed cannot be controlled by indigenous insects. Defoliation of *Melia azedarach* in the Punjab was found to be caused by *Boarmia* (*Ascotis*) *selenaria*, Schiff., which is only lightly parasitised; this Geometrid occurs throughout India on a variety of plants. Although the incidence of *Urostylis punctigera*, Westw., on *Michelia champaca* remains

moderately low and localised, new plantations are not being formed at present in Bengal. Lists are given of Magnoliaceae on which this Pentatomid feeds in Assam and of those on which it was not found. The eggs are parasitised by the Pteromalid, *Pachyneuron pentatomivora*, Mani [*cf.* **28** 510], and both eggs and nymphs are destroyed by predators.

Margaronia pyloalis, Wlk., which defoliates mulberry (*Morus indica*), was parasitised in the Punjab by a Tachinid and 12 Hymenoptera, of which the Braconid, *Phanerotoma hendecasiella*, is the only one specifically identified, and by 7 additional species at Dehra Dun. In experiments on the insect transmission of spike disease of sandal (*Santalum album*) in Madras [*cf.* **28** 558], suspicious symptoms were produced by *Coccosterphus tuberculatus*, Motsch., *Jassus indicus*, Wlk., *Moonia albimaculata*, Dist., and *Nezara viridula*, L. ; these symptoms have not yet been transmitted by grafting.

The life-history of *Pagiophloeus longiclavis*, Mshl., the collar borer of mahogany (*Swietenia macrophylla*), was studied in the insectary in Madras and at Dehra Dun. Weevils of the overwintering generation begin to emerge in late April or May and are present and continue to oviposit throughout the monsoon season. There are two generations and sometimes a partial third during the year. The first generation may be completed between May and August, and the second between August and October, the third developing from eggs laid in October, but owing to the varied rate of larval development and the longevity of the adults, the generations overlap considerably. Mahogany plants are liable to attack for about 6 months ; pulling up the attacked plants is not considered an economic method of control, but the use of freshly cut billets of *Cedrela toona* as traps shows promise. Mahogany was more liable to attack in plantations on open sites than in those with overhead shade given by canopy. Deep undergrowth in clear-felled plots protects the mahogany even more effectively. Cage and field observations in two divisions in Madras showed that larvae of the Pyralid, *Hypsipyla robusta*, Moore, of almost all ages were able to leave a slow-growing shoot of mahogany and attack another. The percentage of shoots attacked ranged from 33 to 80, and the numbers of larvae present averaged about half the number of attacked shoots. Experiments with sack bands showed that *H. robusta* did not breed in the crowns of other meliaceous trees enough to have any appreciable effect on the incidence of attack in young mahogany plantations. Pruning injured shoots stimulated further shoot production and raised the incidence of attack. Shade had the same effect on *H. robusta* as on *P. longiclavis*, and it is considered that further silvicultural control can be obtained by shortening the period of production of lateral shoots.

Work on the biological control of the teak defoliators, *Hapalia machaeralis*, Wlk., and *Hyblaea puera*, Cram. [**28** 537] is briefly reviewed. Parasites imported from Burma and liberated in the field against them [*cf. loc. cit.*] also included the Tachinid, *Ptychomyia remota*, Aldr., which was released in Madras in July 1938.

GARTHWAITE (P. F.). **Entomological Research.**—*Rep. Silv. Ent. Burma 1938–39* pp. 94–106. Rangoon, 1940.

Records are given of the attack on teak [*Tectona grandis*] by *Xyleutes ceramicus*, Wlk., in the experimental plot in Burma in 1937 and 1938 ;

as the trees are now becoming too large to permit thorough investigation and the work is therefore being discontinued, the results obtained since 1930 [*cf. R.A.E.*, A **25** 454; **26** 338] are summarised and discussed. The incidence of the Cossid was much greater in 1930–33 than in the later years, when it was of only moderate intensity. In the years since 1933, about 25 per cent. of the attacks have been recorded in September or later and are, therefore, considered to represent transfers of the larvae from other trees. The numbers of living larvae in the trees were greatest in July–August of each year and later rapidly decreased. In each generation, an average of 11 per cent. of the original larval population survived into the second year, 3·3 per cent. having given rise to adults after one year and the remainder having died. In 1931 and 1937, 33 and 23 per cent. of these survivors gave rise to adults, but no larvae of the 1935, 1936 and 1938 generations lived through the second year. The greatest numbers of larvae died in August and September each year, but the percentage mortality was greatest in April–June in three years and in November in two. Between 1932 and 1939, 56 moths emerged in the acre plot, 68 per cent. after one year in the larval stage and the remainder after two years. Males were more numerous than females. It was found that attacks did not necessarily originate from moths emerging in the plot itself. The average incidence of attack was directly proportional to the girth of the trees and was slightly greater in those growing on a slope with a north-east aspect than on one facing the south-west [*cf.* **25** 454]. The dominant trees in a stand are more liable to infestation than suppressed ones. An experiment begun in 1937 in which larvae were placed on trees in a cage at Zibingyi showed that the percentage mortality of established larvae was 83, even when all natural enemies were excluded. The incubation period at Zibingyi varied from 15 days in March at an average maximum temperature of 93·9°F. to 12 days in April at one of 101·8°F.

Data from 17 localities showed that the percentage parasitism of *X. ceramicus* by *Nemeritis tectonae*, Perkins, decreases as the trees grow older. For trees up to 7–8 years old, the percentage parasitism varied from 20 to 80 and sometimes reached 100 during the first 2–3 years of the attack, but by the time the trees were 20 years old this percentage was never as high as 20 and often 10 or less. The observations showed that *N. tectonae* parasitises larvae in the small wood of saplings and in the crowns of older trees in preference to those in the main trunk, and though the site of borer attack moves up the tree as it gets older [*cf.* **25** 301], that of attack by *Nemeritis* is considerably higher than the majority of the larvae. In a search for an alternate host of *Nemeritis* [*cf.* **25** 75], a young larva of a species of *Indarbela*, probably *I. quadrinotata*, Wlk., was found under the bark in the fork of a 3-year-old teak shoot on 1st March 1939, and a male of *N. tectonae* emerged from it on 4th April. Cossids of the genus *Indarbela* are widely distributed throughout Burma and are numerous in localities in which *Nemeritis* has not been recorded from *X. ceramicus*. Larvae and a living pupa of *X. ceramicus* were found in the stems of *Clerodendron infortunatum*, from which this Cossid has not previously been reported.

No serious outbreaks of *Hyblaea puera*, Cram., or *Hapalia machaeralis*, Wlk., which defoliate teak, occurred during the year, probably owing to abnormally high rainfall throughout Burma during May. Parasitism of larvae and pupae of *Hyblaea* bred in the insectary reached 9 per

cent., of which 50 per cent. was caused by *Apanteles* spp. and 35 per cent. by Tachinids. Other parasites of *Hyblaea* studied were *Brachymeria euploeae*, Westw., and the Ichneumonid, *Echthromorpha notulatoria*, F. The latter was shown to have an egg capacity of about 160, and 64 progeny were obtained from 387 host larvae presented to one female. *B. euploeae* readily parasitised the pupae, but did not attack larvae in any instar. Of nearly 1,500 eggs of *Hapalia* collected in the field, 5·6 per cent. were parasitised ; 89 per cent. of the parasites were *Telenomus usipetes*, Nixon, and the remainder *Trichogramma* sp. [stated in a recent paper (**28** 538) to have been identified as *Trichogrammatoidea nana*, Zehnt.]. A list is given of the parasites found attacking the larvae in the field ; *Apanteles machaeralis*, Wlkn., accounted for 20 per cent. of the total parasitism (6·5 per cent.) and unidentified Tachinids for 41 per cent. The most important parasites of the pupae, 9·5 per cent. of which were parasitised, were *Tetrastichus* sp., *B. euploeae* and *Xanthopimpla cera*, Cam. Breeding of the introduced parasite, *Cedria paradoxa*, Wlkn. [**28** 537] was continued throughout the year, and 103,000 individuals were liberated in 10 regeneration centres in Lower Burma ; although the host population was low, recoveries were made in three localities in May and November 1938 and in February 1939. It is doubtful whether this Braconid survives the hot weather, as maximum temperatures of 90°F. and over apparently inhibit reproduction. No further breeding is to be carried out, as it is considered that the parasite has been released in sufficient numbers to become established if it is able to do so. Small numbers of the Ichneumonid, *Angitia* (*Dioctes*) *gardneri*, Cushm., and the Bethylid, *Goniozus montanus*, Kieff., obtained from Madras [*cf.* **28** 538] were liberated for the control of *Hyblaea*, and unsuccessful attempts were made to breed both parasites in the insectary. No recoveries of either were made during the year. In addition to *Apanteles* spp. and Tachinids, which parasitise *Hyblaea* [*cf.* **28** 537], parasites shipped to India comprised *Tetrastichus* sp. and *Bracon* (*Cremnops*) *desertor*, L., which are parasites of *Hapalia*. It was subsequently reported that both *Tetrastichus* sp. and *B. desertor* were already present in India.

Most of the other defoliators of teak are sporadic, but occasionally cause fairly severe defoliation and delay the recovery of the trees from attacks by *Hapalia* and *Hyblaea*. The most important of those bred during the year were *Boarmia* (*Ascotis*) *selenaria*, Schiff. (*imparata*, Wlk.), *B.* (*Serraca*) *infixaria*, Wlk., *Hyposidra talaca*, Wlk., *Macalla plicatalis*, Hmps., *Astycus lateralis*, F., on young plants, two species of *Apogonia*, and Orthoptera.

Investigations in December on *Pachydissus birmanicus*, Gardner, which bores in *Xylia dolabriformis*, showed that 12 trees with an average girth at breast height of 4 ft. 4 ins. contained a total of 316 galleries of this Cerambycid ; one tree contained no galleries and another 75. The galleries contained 3 large living larvae that must have been in the trees for more than a year and 37 less than $\frac{1}{2}$ in. long that must have hatched from eggs laid in October. Records showed that most of the adults emerge in October, though one emerged in January and a few in April. A living beetle was found in the pupal chamber of a gallery opened in December. The mature gallery, which is large, takes 2 or 3 years to occlude and is frequently the site of incipient rot and termite injury. The Cerambycid can mature in wood only 9 ins. in girth, and galleries were found in the small branches of the crowns. Over 80 open galleries were counted in one tree that

had been killed by *Pachydissus* ; in this case the sapwood must have been entirely consumed. The leading shoot of one of the trees examined had been killed in the same way. The Cerambycid has few natural enemies ; no parasites were found, and only 3 of the 316 galleries examined had been investigated by woodpeckers, though these were numerous. It is probably distributed throughout Burma, but economic damage was reported from only 4 divisions, and control measures are considered to be unnecessary. The only other important borers of *X. dolabriformis* are *Zeuzera coffeae*, Nietn. [**27** 693] and species of *Indarbela* ; the latter injure trees in the pole stage but are largely confined to the crowns of older trees. Detailed investigations on the status and life-history of *Indarbela* showed that the majority of the adults emerge in March, but that small larvae were present in February ; it is considered that these would probably give rise to adults in October–November. The pupal stage lasted about 20 days. Species of *Indarbela* have been recorded from 10 food-plants, of which *X. dolabriformis* appeared to be preferred. A list is given of the leaf-eating insects recorded from *X. dolabriformis* during the year ; the most important were *Maruca testulalis*, Geyer, *Striglina scitaria*, Wlk., and *Achaea janata*, L., but no serious damage was caused.

Logs of *Swintonia floribunda* were attacked by the Scolytids, *Xyleborus fallax*, Eichh., and *X. submarginatus*, Bldf., and the weevils, *Zeugenia histrionica*, Pasc., and *Trochorrhophalus dipterocarpi*, Mshl. ; the percentage of wood rendered useless by infestation averaged about 5 and rose to 50 in some logs, but speedier transport to the mill largely eliminated damage by insects later in the year. Logs of *Anogeissus acuminata* were attacked at the depot by the Bostrychid, *Heterobostrychus aequalis*, Waterh., and the Lyctid, *Minthea rugicollis*, Wlk., and in the forest after felling by the Cerambycid, *Stromatium longicorne*, Newm., and the Lamiid, *Olenecamptus indianus*, Thoms. To determine the relative resistance of barked and unbarked logs of *Pentacme suavis* to attack by borers, two adjacent trees were felled in May and the bark was removed from one of them. This tree remained virtually unattacked, but the other became heavily infested by species of *Sphaerotrypes*, *Xyleborus* and *Diapus* and to some extent by the Cerambycid, *Dialeges pauper*, Pasc., and the Brenthid, *Amphicordus improportionalis*, Hllr.

Sarcocephalus cordatus was severely defoliated in one forest area by the Pyralid, *Margaronia* (*Glyphodes*) *punctiferalis*, Wlk., in June, and *Dipterocarpus tuberculatus* by the Lymantriid, *Dasychira cerigoides*, Wlk., which was first observed in September, had completely defoliated trees over large areas in several reserves by November and continued to cause severe injury until the end of May 1939, apparently completing its life-cycle in about 75 days. *Cassia* trees were severely defoliated by the Pierids, *Catopsilia crocale*, Cram., and *Terias blanda silhetana*, Wallace. Observations on the life-history of *Xyleutes persona*, Le Guillou, which bores in living *Cassia*, were continued [*cf.* **27** 693]. In Rangoon, 89 moths emerged from the 75 trees under observation ; emergence occurred in every month except June, but was most abundant in February, March and September. In Maymyo, 5 moths emerged from 53 trees in April–May and 2 in October ; a heavy population of larvae of various sizes in one tree was killed by injecting a concentrated solution of paradichlorobenzene in kerosene into the galleries. Tung trees (*Aleurites fordi* and *A. montana*) are sometimes

defoliated in the Shan States by *Achaea janata* [*cf.* **27** 693] and *Dasychira mendosa*, Hb., and seedlings up to 2 years old may be severely damaged by the leaf-feeding adult of *Astycus lateralis*. A large root-feeding Prionid killed several seed bearers of *A. fordi* and also attacked *A. montana*.

MARSHALL (Sir G. A. K.). **The Indian Species of** *Calandra*, **F. (Col. Curcul.).**—*Bull. ent. Res.* **31** pt. 2 pp. 123–125, 2 figs. London, 1940.

A key is given to the eight Indian species of *Calandra*, which include three new ones. These, which are described from examples of both sexes, are *C. vateriae*, from seeds of *Vateria indica* in South India, *C. conicollis* from unknown seeds in the Andaman Islands, and *C. erosa* from Burma and Assam. The genus is more strongly represented in the Oriental region than in any other part of the world ; in addition to the Indian species, four others occur east of India, and ten undescribed species, mostly from the Malayan Subregion, are known to the author.

The importance of retaining the well-known generic name of *Calandra*, instead of *Sitophilus*, is emphasised. Application for its retention has been made to the International Commission on Zoological Nomenclature.

FERRIÈRE (C.). **On some Parasites and Hyperparasites of** *Artona catoxantha*, **Hamps.**—*Bull. ent. Res.* **31** pt. 2 pp. 131–139, 5 figs. London, 1940.

The results are given of a study of collections of Chalcidoid parasites and hyperparasites of the well-known coconut pest, *Artona catoxantha*, Hmps., received from Java and Malaya. They comprise *Brachymeria punctiventris*, Cam., *B. lugubris*, Wlk., *Eurytoma albotibialis*, Ashm., *Eupelmus catoxanthae*, sp. n., *Anastatoidea brachartonae*, Gahan, *Euplectromorpha viridiceps*, sp. n., *Pleurotropis detrimentosus*, Gahan, *P. ptychomyiae*, sp. n., *Syntomosphyrum obscuriceps*, sp. n., and *Melittobia hawaiiensis*, Perkins, all of which occur in both countries ; *B. apicicornis*, Cam., *Dirhinus banksi*, Rohw., *Neoplectrus bicarinatus*, gen. et sp. n., *N. maculatus*, sp. n., *Euplectromorpha artonae*, sp. n., and *Syntomosphyrum zygaenarum*, Ferrière, with var. *nigricoxis*, n., from Java ; and *Stomatoceras* sp. and *Tetrastichus* sp. from Malaya. Descriptions of the new genus, species and variety, and of the male of *A. brachartonae*, which was hitherto unknown, are included. The Eulophid genera *Neoplectrus* and *Euplectromorpha* are invariably primary parasites of *Artona*, and *Eurytoma* and *Eupelmus* can be either primary or secondary. The other species are hyperparasites in the Tachinids, *Ptychomyia* and *Cadurcia*, the Ichneumonid, *Goryphus* sp., or the Braconid, *Apanteles artonae*, Rohw.

WILKINSON (D. S.). **On the Identity of** *Apanteles praepotens*, **Haliday (Hym. Bracon.).**—*Bull. ent. Res.* **31** pt. 2 pp. 141–144, 2 figs. London, 1940.

The author redescribes both sexes of *Apanteles praepotens*, Hal., from material collected in England ; he has also examined the type and specimens obtained in Germany. The English specimens were

reared from *Tortrix viridana*, L., *Erannis defoliaria*, Clerck, and *Operophtera brumata*, L., and the German examples have been recorded from *O. brumata* and *O. fagata*, Scharfenb. Other host records, reviewed from the literature, are believed by the author to be incorrect.

FERRIÈRE (C.). **Note on two Egg-parasites of *Antestia lineaticollis*, Stål.**—*Bull. ent. Res.* **31** pt. 2 pp. 145–146, 1 fig. London, 1940.

The Pteromalid, *Acroclisoides africanus*, sp. n., is described from adults of both sexes reared from eggs of the coffee bug, *Antestia lineaticollis*, Stål, in Kenya and a male collected on a coffee plant in the Belgian Congo, and a note is given on the status and synonymy of *Anastatus antestiae*, Ferrière (*brevipennis*, Ferrière), which is also an egg-parasite of *Antestia lineaticollis*. *A. antestiae* was originally described from males received from Uganda in 1925, but was then erroneously thought to be a variety of *A. bifasciatus*, Boy. [*R.A.E.*, A **18** 425]. Further males bred from eggs of *Antestia* were subsequently received from Kenya and Uganda, and in 1935, the author described small, short-winged females bred in Uganda from eggs of an unknown bug as *Anastatus brevipennis*, sp. n. They were, however, females of *A. antestiae*, as was shown when adults of both sexes were bred from eggs of *Antestia* in Kenya. Males of two other supposed varieties of *Anastatus bifasciatus* were described as *longiclava*, Ferrière, and *hancocki*, Ferrière, at the same time as *A. antestiae*. They differ from the latter only in the structure of the antennae and should be considered varieties of it. Both are here stated to have been reared from eggs of *Antestia*.

PARSONS (F. S.). **Investigations on the Cotton Bollworm, *Heliothis armigera*, Hübn. Part III. Relationships between Oviposition and the Flowering Curves of Food-plants.**—*Bull. ent. Res.* **31** pt. 2 pp. 147–177, 8 figs., 22 refs. London, 1940.

The following is substantially the author's summary of this paper, which is one of a series dealing with investigations on *Heliothis armigera*, Hb., in South Africa [*R.A.E.*, A **28** 227, 534]: Studies of the food-plant associations of *H. armigera* have established that, for all practical purposes, egg-laying may be considered to be confined to the flowering period. Evidence of coincidence of the oviposition and flowering curves is submitted for 21 species of short-flowering crops and weeds and 8 species of long-flowering crops. Records from nearly 1,000 crops were consulted for the conclusions drawn.

With regard to short-flowering species, the peaks, as well as the confines, of the oviposition and flowering curves are closely related. Oviposition on long-flowering species may decline while flowering is still in progress, or two or more waves of oviposition may be evident according to the number of moth flights spanned by the flowering period. The courses of oviposition on long-flowering species are interpreted through knowledge of the train of moth flights; although egg-laying in quantity occurs within the flowering period, peak-layings frequently are not aligned with maximum flower-production because the calendar times of moth flights are displaced in relation to it.

Variations of the relationships are noted and their causes discussed, *viz.*, the influence of counter-attractive crops, fluctuations in the moth population, overlap of flowering and moth flight curves, inter-crop

movement of moths, and discrimination by the egg-laying moth between varieties and strains of a plant species. Diversion of moths by a more attractive neighbouring crop is the most frequent cause of variations, and examples are given with special reference to cotton. Several of the causes of variation operate in layouts of randomised plots and increase the difficulties of experimental work and plant breeding to an extent that may not be appreciated when the relative merits of strains and treatments are judged. Exceptions to the relationships are noted. Their detection was incidental to the purposes of the work, and no attempts were made to prosecute studies regarding them.

Attention is drawn to the immediate utility of the relationships in attempts at evasion and control, the exceptional aids they afford to the study of subjects bearing at longer range on a proper understanding of the bollworm problem, and their offer of initial guides to the study of the nature of the attraction. The results of preliminary tests for olfactory perception by the moths of steam distillates and alcohol extracts from flower materials from different sources are communicated, as they encourage further and more precise investigation. It is suggested that food and oviposition responses are distinct. Whether the moths are actuated primarily by perception of the more complex flower scents and recognise differences that lie at the base of food-plant preferences remains to be established. It is, however, noteworthy that the timing of oviposition with flowering results in the larvae having access to food which favours optimum reproduction of the species. Thus, apart from questions of perception, the relationships manifest instinctive behaviour.

Particulars are given of the times and extent to which eggs were disseminated on a number of flowering crops and wild food-plants in small acreages on a native holding in the Swaziland Protectorate. Oviposition on the cotton was comparatively light, although infestation on unprotected European cotton was exceptionally heavy, and the findings would seem to confirm the views of workers in other parts of Africa that counter-attractant influences in the multiple-cropping systems of natives there serve to protect the cotton. Possibilities that the area of native-grown cotton might be enlarged at the expense of preferred food-plants of *H. armigera* with a consequent increase in its status as a cotton pest are touched on.

Rahman (K. A.) & Nath (R.). **Bionomics and Control of the Indian Sugar-cane Leafhopper, *Pyrilla perpusilla*, Wlk. (Rhynchota, Fulg.) in the Punjab.**—*Bull. ent. Res.* **31** pt. 2 pp. 179–190, 1 pl., 1 fig., 4 refs. London, 1940.

The following is substantially the authors' summary: *Pyrilla perpusilla*, Wlk., all stages of which are described, is one of the most destructive sugar-cane pests in the Punjab. It is widely distributed and also feeds on wheat, barley, oats, maize, and a number of grasses. A female can deposit 773 eggs in its life-time. The eggs are laid in clusters on the food-plants and are covered with whitish, fluffy material. The egg stage occupies 7–12 days during April–October and 20–41 during November–March. There are 5 nymphal instars. The nymphal stage occupies 24–65 days during April–September and 78–208 during October–March. Both adults and nymphs prefer to feed on varieties of sugar-cane that have broad, fleshy and succulent leaves

and thick, soft stems. As a result of their feeding, sucrose is reduced by as much as 34·2 per cent., while the glucose ratio may be trebled.

The eggs of this Lophopid are parasitised by *Ooencyrtus papilionis*, Ashm., and *Tetrastichus pyrillae*, Crwf., the nymphs by *Dryinus* (*Lestrodryinus*) *pyrillae*, Kieff., and the nymphs and adults by the Stylopid, *Pyrilloxenos compactus*, Pierce. The Coccinellids, *Brumus suturalis*, F., *Chilomenes sexmaculatus*, F., *Coccinella septempunctata*, L., and *C. undecimpunctata*, L., feed on the eggs, and the larvae of a moth of the genus *Epipyrops* are predacious on the adults and nymphs. The incidence and duration of the life-cycles of these parasites and predators are given.

The measures suggested for control comprise the destruction of the adults by hand nets and the eggs by crushing during April ; destruction of the nymphs with a new hopperdozer, which is briefly described and illustrated, during November–March ; and the use of a dust containing nicotine sulphate or a spray containing nicotine sulphate and fish-oil soap.

VESEY-FITZGERALD (D.). **Notes on some Coccinellidae (Col.) from Islands in the Indian Ocean.**—*Bull. ent. Res.* **31** pt. 2 pp. 191–192. London, 1940.

Rodolia chermesina, Muls., occurs on most of the islands of the Seychelles archipelago, where it is thought to have been introduced about 60 years ago for the control of *Icerya seychellarum*, Westw., which was then the most important pest of coconut in the Seychelles. It preys only on *I. seychellarum*, and in general holds it in check, but occasional outbreaks occur when, in addition to coconut, banana, avocado, jak fruit [*Artocarpus integrifolia*], bread fruit [*A. incisa*], *Citrus* and seedlings of forest trees, including *Eucalyptus*, *Albizzia* and *Casuarina*, are damaged. No parasites of *R. chermesina* have been observed, but it is attacked by *Technomyrmex detorquens*, Wlk. (*albipes*, F. Sm.), which occurs in large numbers in association with *I. seychellarum*. The female beetles deposit their eggs singly, in pairs or in irregular groups on leaves, beneath the remains or in empty skins of *I. seychellarum*, or on the bodies or among the waxen caudal filaments of living Coccids. The immature stages are briefly described. The egg stage, three larval instars, and the pre-pupal and pupal stages occupy 4, 2–3, 3–4, 2–3, 2–3 and 7 days, respectively, and the adults live for 5–8 weeks. The latter can pair within two days, and oviposition begins four days after emergence. A male survived captivity for 35 days and a female for 43 days ; the latter deposited 150 eggs during a period of 16 days, the largest number laid on a single day being 28. A second female deposited 311 eggs in 27 days. *R.* (*Vedalia*) *cardinalis*, Muls., also feeds on *I. seychellarum* in the laboratory, but has failed to become established when liberated [*R.A.E.*, A **28** 330].

During 1939, *Exochomus flavipes*, Thnb., which normally attacks soft scales and mealybugs (*Pseudococcus*), was introduced into the Seychelles proper ; it already occurred in some of the southern coral islands [*cf.* **27** 335]. Its survival on small oceanic islands probably results from its ability to feed and breed on a wide range of prey. A fairly large population of adults of this Coccinellid was observed attacking Diaspine Coccids on a small island on an atoll reef where it had apparently previously exterminated a species of *Pulvinaria* ; the beetles also fed on small dead flies that had been attracted to light at

night. In Madagascar, both adults and larvae were observed feeding on adult Chironomids resting during the day on a low hedge ; no Coccids were found in the vicinity.

MOUTIA (L. A.). **The Search for Parasites of White Grubs (Melolonthids) in Zanzibar, Algeria, Morocco and France.**—*Bull. ent. Res.* **31** pt. 2 pp. 193–208, 4 pls., 5 figs., 12 refs. London, 1940.

The following is based chiefly on the author's summary : An extensive survey covering a period of 18 months was carried out in Zanzibar, Algeria, Morocco and some parts of France with a view to obtaining parasites of white grubs for furthering the control of *Lachnosterna* (*Phytalus*) *smithi*, Arr., on sugar-cane in Mauritius [*cf. R.A.E.*, A **28** 303].

In Zanzibar, the survey showed that white grubs are of no great economic importance in plantations of clove [*Eugenia aromatica*]. Larvae of *Entyposis impressa*, Kolbe, *Schizonycha* spp., *Anomala delagoa*, Péring., and *Anomala* sp. were parasitised by the Tachinid, *Microphthalma europaea*, Egg. (*disjuncta*, auct.). The percentages parasitised were from 0·10 to 0·53. Scoliids were not very numerous ; the rate of parasitism was 0·6 per cent. The adults of *E. impressa*, *Schizonycha* spp. and *A. plebeja*, Ol., were parasitised by the Tachinid, *Pexopsis pyrrhaspis*, Villen., and those of one species of *Schizonycha* by an Ortalid of the genus *Adapsilia*. The percentages parasitised varied from 1 to 9·7. In Algeria, amongst the most important white grubs are *Geotrogus deserticola*, Blanch., *Rhizotrogus euphytus*, Buq., *R. amphytus*, Buq., *R. stupidus*, Fairm., and *R. numidicus*, Lucas. In a heavily infested centre, 12,000 larvae of *G. deserticola* were examined, but the rate of parasitism was only 0·06 per cent., the parasite being a species of *Microphthalma*. Entomogenous fungi were here well distributed, the percentage of larvae attacked by *Metarrhizium anisopliae* being 4·8. Parasitism of larvae by Tachinids in other areas was nil or very slight (0·06 per cent.). Amongst the Scoliids found in the various infested centres, the commonest was *Campsomeris ciliata*, F. No effective means of control against white grubs were obtained from this part of North Africa. In France, in large pastures in the region of Rouen, the commonest species was *Melolontha melolontha*, L., the larvae occurring at the rate of from 200,000 to 320,000 per acre. About 10,000 larvae were examined, but no parasite was found. One lawn in Rouen was severely infested with larvae of *Amphimallus solstitialis*, L., and *A. majalis*, Raz. ; no parasite was found in 5,000 larvae examined. In the region of Arles and Avignon, it was reported that white grubs in some areas are kept under control by the flooding of the vineyards that occurs during 40–50 days each year. In Morocco, Lamellicorn larvae of four species were found in forests of cork-oak [*Quercus ilex* var. *suber*] : 50 per cent. were *A. semivillosus*, Fairm., 25 per cent. *R. carduorum*, Erichs., 21 per cent. *Anoxia* sp., and 2 per cent. *Phyllognathus* sp. Of a total of 561,000 larvae examined, the mean percentage parasitism by *Dexiomorpha picta*, Mg., which attacked all four species, amounted to 1·5, but parasitism is very often local and in small areas may be as much as 16 per cent. The relation between the degree of parasitism and the rainfall and temperature is shown graphically.

The bionomics of *D. picta* in Morocco are fully discussed, and the morphology of the various stages is described. The rôle of other

parasites and predators of the larvae and adult beetles is considered. An account of the methods of packing and shipping larvae parasitised by *Dexiomorpha* to Mauritius is given. The larvae were shipped in cold storage at 4–6°C. [39·2–42·8°F.], and the survival rate was from 49 to 80 per cent. The percentage of flies emerging from the total number of parasitised larvae sent ranged from 10 to 26·9. The results of this work on North African parasites indicate that *D. picta* is the only Tachinid that is worth further attention. It is very desirable to continue the importation of this species so that a large number of individuals can be made available for release in Mauritius. Improvements in the technique of reception and breeding have been made, and in view of the wide host range, the fly may be said to be the most promising larval parasite yet discovered. Of the Scoliids, it appears that larvae of *Tiphia* cannot survive the long journey to Mauritius, but in future, attempts may well be made to ship pupae. The species of *Campsomeris* do not seem to be of any importance, and little time should be spent on them.

Brain (C. K.). **Host Plants of the Tobacco Aphis,** *Myzus persicae*.—*Rhod. agric. J.* **37** no. 5 pp. 254–255. Salisbury, S. Rhod., 1940.

Rosette disease of tobacco in Southern Rhodesia is transmitted by the Aphid, *Myzus persicae*, Sulz. [*cf. R.A.E.*, A **27** 226, etc.], infestation by which has increased in recent years and is severe in certain districts. Until a few years ago, the Aphid was apparently restricted there to Turkish and late varieties of tobacco, but it has now spread to Virginia tobacco and is a serious pest of early-planted crops. It is the only Aphid recorded from tobacco in Southern Rhodesia. Little is known of its other food-plants there [*cf.* **27** 125], and since a knowledge of them is essential for working out control measures, a list, compiled from a work already noticed [**28** 440], is given of plants that either occur in Southern Rhodesia or are closely related to those that do so from which the Aphid has been recorded in various parts of the world.

Department of Scientific and Industrial Research. **The Principles of Fumigation of Insect Pests in Stored Produce.**—[3] 28 pp., 7 figs., 15 refs. London, H.M.S.O., 1940. Price 6*d*. net.

The purpose of this pamphlet, which has been prepared by A. B. P. Page and O. F. Lubatti, is to make known the general scientific principles that govern the successful use of fumigants in particular conditions of storage. The factors to be considered are that the gas must reach all places at which insects are to be found, remain there for a sufficient time and at a sufficient concentration to destroy the insects, and be driven out of the building in order to make it safe and remove taint from the fumigated goods after treatment.

The subjects discussed include the vaporisation of the fumigants, most of which are supplied as liquids, in warm weather by spraying or evaporation from porous materials and in cold by vaporisers in which inflammable fumigants are heated by hot water and others by electric heaters, examples of both types being described and figured; the even distribution of the gas, which is obtained by stirring the air, by

convection currents, as when sulphur is burnt, or to some extent by liberating the fumigant at many well-distributed points ; penetration, which takes place mainly by diffusion, except in vacuum fumigation, and is affected by the size and disposition of the intergranular spaces and hindered by absorption either in the goods or in the packing material, but may be increased by stacking the packages to obtain the maximum exposure, circulating the fumigant or actually mixing it with the produce ; and airing, which must be continued for some time after the concentration in the air has fallen to a safe value for the removal of absorbed fumigant. It is emphasised that the choice of fumigant and the intensity of treatment should be such as to ensure the minimum amount of residual fumigant in the food and the least possible risk of damage to its nutritive value. To reduce the waste of fumigant by leakage and absorption, the use of special fumigation chambers, the construction of which is described, is recommended. It is often advantageous to fumigate under slightly reduced pressure, while fumigation under greatly reduced pressure may increase the susceptibility of insects and assist penetration and airing.

Owing to the specific nature of the toxic action of fumigants, both the species and the stage of development of the insects to be killed must be determined, and account must be taken of the exact conditions in which they are found. The effects of various conditions on the resistance of the insects are shown ; a rise in temperature, the addition of carbon dioxide and the reduction of the oxygen content of the atmosphere all increase their susceptibility to fumigants ; change of pressure, or of humidity together with the moisture content of the food, may affect resistance, and disturbing the insects affects some insects seriously and others not at all. It is difficult to introduce certain insects into goods, to serve as controls, without decreasing the resistance of the insects or changing the packing of the goods, and inspection of the goods and buildings at intervals before and after fumigation, though it may be misleading, is frequently the best biological test of a fumigant. A single fumigation is rarely satisfactory, owing to reinfestation, and a system combining fumigation with some other method of control, such as spraying, is usually necessary. Such measures as cleanliness and segregation of goods are of fundamental importance.

Brammanis (L.). **Latvijas mežu kaitekļu apskats.** [A Survey of the Forest Pests in Latvia.]—*Mežkopja darbs un zinātne* 1–2 1940 pp. 257–340, 33 figs., 1 map, 81 refs. [Riga] 1940. (With a Summary in German.)

About a quarter of the total area of Latvia is covered by natural forest consisting chiefly of spruce and pine, with an admixture of aspen (*Populus tremula*) and birch. Unmixed spruce or pine occupies less than a quarter of the forest area. The balance of nature is in general well maintained, and the action of man is mainly responsible for outbreaks of forest pests.

The habits and economic importance of a large number of pests are discussed, and the injury that they cause is described. Outbreaks of primary pests seldom occur in the natural forest owing to the variable climate, the short vegetation period and the mixed nature of the stands. Thus, there has been no outbreak of *Lymantria* (*Ocneria*)

monacha, L., since 1913, although the moth was numerous in 1934–36 in East Prussia. The pine moths, *Panolis flammea*, Schiff., *Bupalus piniarius*, L., *Dendrolimus pini*, L., and *Sphinx pinastri*, L., are equally unimportant, though the last-named increased locally during the period in which it became abundant in Poland [*R.A.E.*, A **27** 676]. An outbreak of *Neodiprion* (*Diprion*) *sertifer*, Geoff., on pine occurred in 1937–38 [*cf.* **28** 8] ; parasites reared from the cocoons comprised *Microcryptus basizonus*, Grav., and *Exenterus abruptorius*, Thnb., which were numerous, and *E. marginatorius*, F., and *Torocampus eques*, Htg. In some years, *Tortrix viridana*, L., becomes abundant on oak, and *Operophtera brumata*, L., on birch and other deciduous trees. The most numerous secondary pests are bark-beetles, of which at least 50 species occur, and Longicorns, but their importance is very reduced where planned felling is carried out. The seeds of spruce are injured by *Cydia* (*Laspeyresia*) *strobilella*, L., an outbreak of which occurred in 1937–38 in northern Latvia.

The two chief pests that have been favoured by disturbance of the natural conditions are *Hylobius abietis*, L., and *Melolontha hippocastani*, F. The former is common in unmixed stands of pine, especially those near felled areas. In experiments, fair control was given by exposing pine twigs sprayed with calcium arsenate in small pits, and by spraying the trees with a proprietary arsenical. *M. hippocastani*, which has a five-year life-cycle, is common in forest areas of mixed pine and birch in eastern Latvia, and is favoured by forest fires. A flight-year occurs in 1941 [*cf.* **28** 8].

A brief section is appended on insects that infest structural timbers in buildings in Latvia. Of these, the most important is *Hylotrupes bajulus*, L., which is widely distributed in coastal districts, but it has not yet caused serious damage.

Crawford (J. C.). **The Male of** *Heliothrips haemorrhoidalis* **(Bouché) (Thysanoptera).**—*Proc. ent. Soc. Wash.* **42** no. 4 pp. 90–91, 1 fig. Washington, D.C., 1940.

A description is given of the hitherto unknown male of *Heliothrips haemorrhoidalis*, Bch., based on a single specimen taken in April 1939 together with one female at the port of New York on a fruit of *Eugenia* from Colombia. This thrips is usually confined to greenhouses in the cooler parts of the temperate zones, but the author observed it in the open on Long Island (New York) in September 1935 on rhododendrons and azaleas on an estate on which there were no greenhouses.

Muesebeck (C. F. W.). **Two new reared Species of** *Bassus* **(Hymenoptera : Braconidae).**—*Proc. ent. Soc. Wash.* **42** no. 4 pp. 91–93. Washington, D.C., 1940.

Descriptions based on adults of both sexes are given of the Braconids, *Microdus* (*Bassus*) *nucicola*, sp. n., which was reared from *Cydia* (*Melissopus*) *latiferreana*, Wlsm., in oak-apple galls and acorns in California, and *M.* (*B.*) *pini*, sp. n., of which nine examples were reared from *Rhyacionia comstockiana*, Fern., in Maine, Ohio and

New York, and three were stated to have been reared, respectively, from *R. frustrana*, Comst., in Massachusetts and unidentified species of *Rhyacionia* (*Evetria*) on pines in Pennsylvania and Virginia.

GARMAN (P.). **Oriental Fruit Moth Parasites.**—*Circ. Conn. agric. Exp. Sta.* no. 140 pp. 29–47, 3 figs., 6 maps, 2 graphs. New Haven, Conn., 1940.

This is a survey of work in Connecticut in 1930–38 on the biological control of the oriental fruit moth [*Cydia molesta*, Busck] on peach [*cf. R.A.E.*, A **28** 642, etc.]. Lists are given of the primary and secondary parasites of the moth that are indigenous in the State and of the introduced species, of which *Angitia* (*Dioctes*) *molestae*, Uch., and *Microdus* (*Bassus*) *diversus*, Mues., imported from Korea and Japan, respectively, appear to be the most important at present. Of the native parasites, the most effective are *Macrocentrus ancylivorus*, Rohw., *Trichogramma pretiosum*, Riley, *Glypta rufiscutellaris*, Cress., and *Eubadizon pleuralis*, Cress. ; the first two have also been introduced and have been bred in large numbers and liberated in many orchards.

In Connecticut, *M. ancylivorus* appears to be on the northern limit of its natural range and may greatly decrease in numbers or disappear from the field during unfavourable periods ; it is recommended, therefore, that stocks should be kept available for distribution whenever this becomes necessary. Unfavourable factors that restrict the value of parasites against *C. molesta* are heavy rains, which destroy the egg parasites and promote abundant twig growth ; temperatures above 70°F. at sunset during the growing season, which favour oviposition by the moth ; scarcity of alternative hosts for parasites such as *Macrocentrus* ; abnormally warm autumns and winters, which allow certain larval parasites to reach a stage in development in which they are subsequently more susceptible to cold or which allows them to emerge in the spring before host larvae are numerous ; and the destruction of the peach crop by cold, which causes a scarcity of food for the third generation of the moth and a consequent reduction of the overwintering parasite population. Favourable conditions for parasites comprise cool autumns, light rainfall during summer, and temperatures below 65°F. at sunset during August.

C. molesta appears to possess a greater intrinsic power of survival than its known natural enemies, and in order to obtain a noticeable reduction in the infestation of fruits it seems necessary that at least 50 per cent. of the eggs should be parasitised, or at least 75 per cent. of the larvae present in July, and increases in parasitism below these limits are of little value. Investigations on the use of *Trichogramma* have shown that liberations are more successful when natural parasitism is low. By exposing parasitised eggs of the grain moth [*Sitotroga cerealella*, Ol.] in peach orchards at the rate of approximately 40,000 per acre over a period of years, the percentage parasitism by *Trichogramma* was increased from 19 to 35 in 1937. Small colonies of 200–500 examples of *Macrocentrus* have been liberated for several consecutive years, but the total percentage of larvae parasitised has been raised only from 4·7 before release to 11·7 in 1937. In 1936–38, the general rate of larval parasitism increased steadily in spite of unfavourable weather. Parasitism by *Trichogramma*, however, increased little or not at all, probably owing to the adverse effects of heavy rains in July and August in 1937 and 1938.

MAKI (M.). **On the Control of** *Crossocosmia sericariae* **Corn., a Parasite of the Silkworm, by parasitic Fungi.** [*In Japanese.*]—*Agric. & Hort.* **15** no. 6 pp. 1279–1282. Tokyo, 1940.

An account is given of experiments in Japan in which full-fed larvae of *Sturmia* (*Crossocosmia*) *sericariae*, Rond., a parasite of the silkworm (*Bombyx mori*, L.), were infected with the entomogenous fungus, *Spicaria* (*Isaria*) *fumosorosea*. The larvae entered the soil and pupated. A white fungous growth appeared after 23 days on both ends of the pupae, which were kept at a temperature of 15–30°C. [59–86°F.], and red spores were formed in 55 days. The percentage of infested pupae was high when the soil was saturated with moisture. The fungus also attacked silkworms in the laboratory, but does not do so under ordinary conditions. It is suggested that the best method of using it for the control of *Sturmia* is to scatter the spores in pupation sites.

PAPERS NOTICED BY TITLE ONLY.

BETREM (J. G.). **A new** *Rhizoecus* **Species** [*R. amorphophalli*, sp. n., from tubers of *Amorphophallus variabilis* in Java].—*Treubia* **17** pt. 4 pp. 267–270, 3 figs. Buitenzorg, 1940.

TAKAHASHI (R.). **Some foreign Aleyrodidae (Hemiptera), 2. A new Species attacking** *Citrus* **in Australia** [*Aleuroplatus citri*, sp. n., on lemon in New South Wales].—*Trans. nat. Hist. Soc. Formosa* **30** no. 205 pp. 381–382, 1 fig. Taihoku, 1940.

DREWS (E. A.) & SAMPSON (W. W.). **A List of the Genera and Subgenera of the Aleyrodidae.**—*Bull. Brooklyn ent. Soc.* **35** no. 3 pp. 90–99. Lancaster, Pa., 1940.

GOLDING (F. D.). **Further Notes on the Food-plants of Nigerian Insects. V.**—*Bull. ent. Res.* **31** pt. 2 pp. 127–130. London, 1940. [*Cf. R.A.E.*, A **25** 464.]

JAYEWICKREME (S. H.). **A comparative Study of the larval Morphology of leaf-mining Lepidoptera in Britain.**—*Trans. R. ent. Soc. Lond.* **90** pt. 4 pp. 63–105, 12 figs., 21 refs. London, 1940.

WING (M. W.). **The Occurrence of** *Gryllus* [*Gryllulus*] *domesticus* **L. in Maine (Orthop. : Gryllidae).**—*Ent. News* **51** no. 8 p. 227. Philadelphia, Pa., 1940.

EVERLY (R. T.). **Spiders and Insects found associated with Sweet Corn** [maize, in Ohio] **with Notes on the Food and Habits of some Species. V. Homoptera and Summary.**—*Ohio J. Sci.* **40** no. 3 pp. 143–146. Columbus, Ohio, 1940. [*Cf. R.A.E.*, A **26** 590 ; **27** 280, 455.]

MORIYAMA (T.). **Studies on the Lethal Effects of Insecticides. Pt. 1. The general Results of previous Experiments with** *Derris* **upon various Species of Insects** [a review of the literature]. [*In Japanese.*]—*Formosan agric. Rev.* **35** no. 10 pp. 765–775 ; no. 11 pp. 870–887. Taihoku, 1939. *Op. cit.* **36** no. 1 pp. 42–72 ; no. 2 pp. 136–171. 1940.

SIEVERS (A. F.). **The Production and Marketing of Derris Root** [a review of the literature].—24 pp. multigraphed, 152 refs. [Washington, D.C.] U.S. Dep. Agric. Bur. Plant Industr., 1940.

WISHART (G.). **An Adaptation of a Standard Bi-metallic Thermo-regulator to control variable Temperatures.**—*Canad. Ent.* **72** no. 4 pp. 78–81, 4 figs., 1 ref. Guelph, 1940.

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ANNALS OF THE QUEENSLAND MUSEUM (BRISBANE): Nos. 1, 5 and 6 (1891–).

ANNUAIRE ET MÉMOIRES DU COMITÉ D'ETUDES HISTORIQUES ET SCIENTIFIQUES DE L'AFRIQUE OCCIDENTALE FRANÇAISE (GORÉE): Vols. I–II (1916–17).

ARCHIVES DE L'INSTITUT PASTEUR DE TUNIS:
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THE BEE WORLD (BENSON, OXON): Vols. I–II (1919–21).

BIOLOGICAL BULLETIN OF THE MARINE BIOLOGICAL LABORATORY (WOODS HOLE, Mass.):
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BOLETIN DE LA DIRECCION DE ESTUDIOS BIOLOGICAS (MEXICO):
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Bulletin du Comité d'Etudes historiques et scientifiques de l'Afrique Occidentale Française (Paris) : Année 1919, No. 1.

California Agricultural Experiment Station (Berkeley, Cal.) :
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Comptes Rendus des Séances de l'Académie d'Agriculture de France (Paris) : Tome VIII (1922) No. 5.

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Entomologica Americana (Brooklyn, N.Y.) :
Vol. IV (1888) Title-page. Vol. V (1889), Nos. 6 & 8.

Entomologische Litteraturblätter (Berlin) : 6. Jahrg. (1906). Nos. 2 & 10.

Experiment Station Record (Washington, D.C.) : Vols. I–IV (1889–94).

Georgia State Board of Entomology (Atlanta) :
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India : Forest Research Institute (Dehra Dun) :
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Indian Medical Gazette (Calcutta) :
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Indiana : Third Annual Report of the State Entomologist, 1909–10.

Journal of the Board of Agriculture of British Guiana (Demerara) : Vol. III No. 1 (1909). Title pp. and Indices to Vols. I–II.

Journal of the South-Eastern Agricultural College (Wye, Kent) : Nos. 1–6, 8, 11–13 (1895–1904).

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New Jersey State Department of Agriculture (Trenton, N.J.) : Bulletin 2 ; Circular : 2, 12, 29 (1917–19).

New York State Museum (Albany, N.Y.) : Bulletin : 26 & 57 (1899–1902).

Ontario Entomological Society Report (Toronto) : 9th (1878).

Ormerod (E. A.). Observations of Injurious Insects and Common Farm Pests during the Years 1877 & 1878 (London, 1878–79).

Philippine Agriculturist and Forester (Manila) :
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Philippine Journal of Science (Manila) : Vol. I (1906) No. 10.

Porto Rico Department of Agriculture, &c. (San Juan) :
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Psyche (Boston, Mass.) : Vols. XI (1904), XIII (1906), XVI (1909).

Records of the Egyptian Government School of Medicine (Cairo) : Vol. I.

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Revista Chilena de Historia Natural (Santiago) : Año XIV (1910) Nos. 4–6 ; XV (1911) Nos. 1 and 3 to end ; XVI, XVIII, XXVI (1912, 1914, 1922).

Revista de Veterinaria e Zootechnia (Rio de Janeiro) :
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La Revue de Phytopathologie appliquée (Paris) : Tome I Nos. 22–23 (April–May, 1914).

Rhodesia Agricultural Journal (Salisbury) :
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Sciencia Medica (Rio de Janeiro) : Anno 1 Nos. 2–3, 5–6 ; II Nos. 1–10, 12.

South London Entomological and Natural History Society :
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